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Source Category Survey: Animal Feed Dryers

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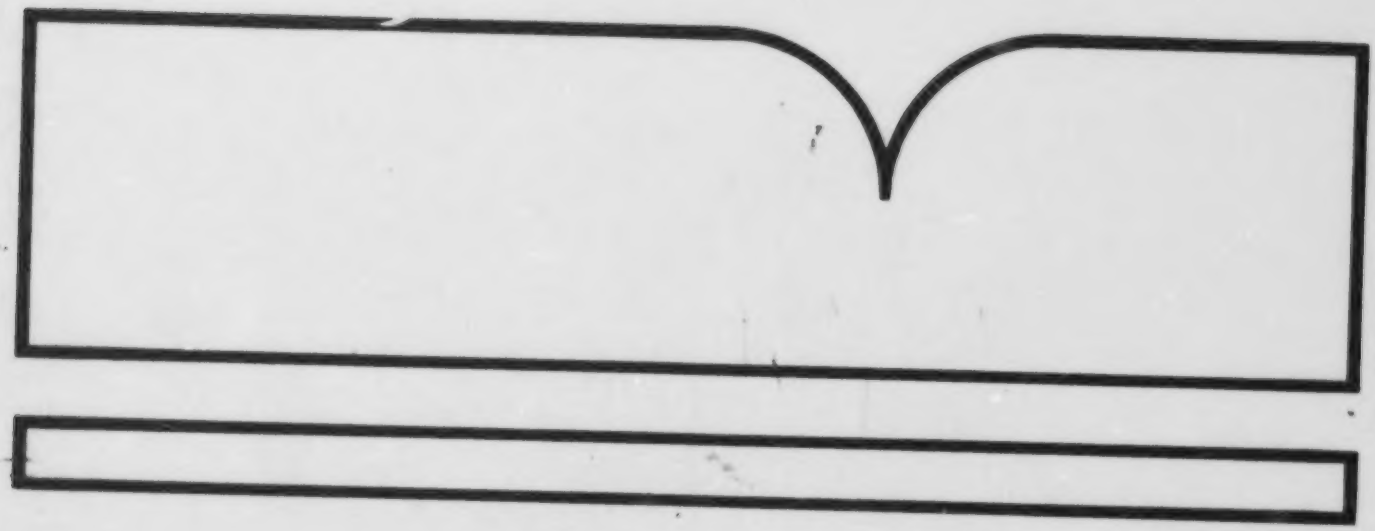

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16. ABSTRACT

This report presents the findings of a study to assess the need for new source performance standards (NSPS) for animal feed dryers. Industries which use animal feed dryers are included in SIC 2046: Wet Corn Milling; SIC 2047: Dog, Cat, and Other Pet Food; SIC 2048: Prepared Feeds and Feed Ingredients for Animals and Fowls; SIC 2063: Beet Sugar; SIC 2075: Soybean Oil Mills; SIC 2077: Animal and Marine Fats and Oils; SIC 2082: Malt Beverages; and SIC 2085: Distilled, Rectified, and Blended Liquors. Information and estimates concerning production, growth, industry structure, and emissions are presented. Animal feed dryers are sources of particulate matter emissions at plants where they are used. Methods of air pollution control and their effectiveness are examined. Summary of State regulations applicable to dryers is given. An estimate of total emission reduction achievable through an NSPS is given.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Animal Feed Dryers Wet Corn Milling Soybean Oil Milling Beet Sugar Pulp Alfalfa Dehydrators Dry Pet Food Manufacturing Fish and Feather Meal Direct-fired rotary dryers Steam-tube rotary dryers Air Pollution Particulate Matter Pollution Control Control Equipment Standards of Performance	Air Pollution Control	13B

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1. SUMMARY

1.1 BACKGROUND

This source category survey report presents information on animal feed dryers, particulate matter emissions, and control equipment in the following Standard Industrial Classification (SIC) Codes:

SIC 2046--Wet Corn Milling
SIC 2047--Dog, Cat, and Other Pet Food
SIC 2048--Alfalfa Dehydrator segment only
SIC 2063--Beet Sugar
SIC 2075--Soybean Oil Mills
SIC 2077--Animal and Marine Fats and Oils
SIC 2082--Malt Beverages
SIC 2085--Distilled, Rectified, and Blended Liquors

Of the above categories, only SIC 2047 (Dog, Cat, and other Pet Food) and SIC 2048 (Alfalfa Dehydrators) produce animal feed as a primary product; the remaining industries produce residuals or byproducts which are dried for sale as animal feed. Information from numerous sources on production, growth, industry structure, and emissions formed the basis for the estimates given in this report. The purpose of these estimates is to allow assessment of the need for a new source performance standard. Therefore, the estimates should not be used for purposes other than intended. Table 1-1 presents estimates made from available information on the number of plants, volume of production, growth trends, level of control, and annual national emissions expected from new, modified, and reconstructed facilities in the source category. Emission data obtained from State and local control agencies, industry representatives, and equipment vendors are summarized in Table 7-1 (Chapter 7).

TABLE 1-1. SOURCE CATEGORY SUMMARY[a]

Industry segment	Current size (1980)			Estimated growth annual %	New/modified/reconstructed facilities (1985)			Annual emissions from new/modified/reconstructed facilities (1985)		
	Plants	Dryers	Production[b] 10^3 Mg/yr (10^3 tons/yr)		Plants	Dryers	Production 10^3 Mg/yr (10^3 tons/yr)	Uncontrolled Mg/yr (tons/yr)	Controlled Mg/yr (tons/yr)	Reduction potential Mg/yr (tons/yr)
Soybean oil mills	121	230	22,680 (25,000)	5	0	56	6,350 (7,000)	4,763 (5,250)	1,905 (2,100)	2,858 (3,150)
Wet Corn milling	46	184	3,084 (3,400)	7.2	19	103	2,268 (2,500)	1,140 (1,256)	794 (875)	346 (381)
Alfalfa dehydrators	180	200	1,089 (1,200)	2	0	22	204 (225)	1,024 (1,129)	306 (338)	718 (791)
Beet sugar	57	110	1,270 (1,400)	0	0	18	209 (230)	626 (690)	159 (175)	467 (515)
Dog, cat, and other pet food	272	120	2,359 (2,600)	5	8	24	635 (700)	508 (560)	81 (89)	427 (471)
Distilled liquor	93	98	445 (490)	5	8	16	181 (200)	454 (500)	181 (200)	272 (300)
Malt beverages	88	60	363 (400)	0	0	5	54 (60)	136 (150)	54 (60)	82 (90)
Animal and marine fats and oils	77	140	508 (560)	5	10	20	218 (240)	65 (72)	14 (15)	51 (57)

[a] MRI estimates from available data.
[b] Mg/yr = megagrams per year.
[c] Estimated reduction potential achievable with application of an emission control device on the animal feed dryer.

1.2 INDUSTRY AND PROCESS DESCRIPTIONS

The drying process in the production of animal feed involves reducing the moisture content of a product to make it suitable for further processing, storage, and use as an animal feed. Numerous types of dryers are available for drying animal feed ingredients: direct-fired rotary, steam-tube rotary, tunnel or conveyor, flash, and ring dryers. In 1980, approximately 32 $x10^6$ megagrams (Mg) (35 x 10^6 tons) of dried animal feeds were sold in the United States.[1] Animal feeds may be divided into four general categories: "oilseed meal," "grain protein feeds," "animal proteins," and "other."

1.2.1 Oilseed Meal

Oilseed meal, which represents the largest industry in the source category, both in terms of production and emissions, includes meal produced at soybean oil mills. Oil is extracted from soybeans by pressing or solvent extraction, and the remaining meal is dried in steam-tube rotary dryers and sold for use as a high protein animal feed. Other oilseed meals (approximately 1 percent of soybean production) are also used for animal feed but the use of dryers is not a uniform practice in these industries. Soybeans accounted for approximately 23 x 10^6 Mg (25 $x10^6$ tons) of the byproduct animal feed produced in 1980, or 70 percent of the total dried byproduct animal feed production.[2]

1.2.2 Grain Protein Feeds

Grain protein feeds, which include feeds produced at wet corn millers, distilled, rectified and blended liquors manufacturers, and malt beverages plants, represent the next largest category of animal feed production. This category accounts for 12.2 percent, or 3.9 x 10^6 Mg (4.3 $x10^6$ tons) of dried byproduct animal feeds.[3,4]

Wet corn milling accounts for 3.1 $x10^6$ Mg (3.4 x 10^6 tons) or 80 percent, of the animal feed production in the grain protein feeds category. In this industry, corn is wet-milled to produce starch. The germ and gluten removed during the process are [illegible]d with the bran, chaff, and steepwater concentrate and dried to produce gluten feed and gluten meal. Wheat and potato wet milling are also included in this category.

1.2.3 Animal Proteins

The animal protein category encompasses the animal and marine fats and oils industrial classification. Fish and feather meal production account for about 0.45 $x10^6$ Mg (0.5 $x10^6$ tons) of dried byproduct animal feed production, or approximately 1.5 percent of the total dried byproduct animal feed produced.[5]

Fish meal is produced at plants that process edible fish and at those that produce fish oil. At oil plants, fish are cooked and pressed to remove the oil, and the fish solids are dried for use as animal feed. In plants that process edible fish, the byproducts are dried to produce fish meal.

Feather meal is produced by hydrolyzing feathers in steam pressure cookers and then drying the resultant meal. Blood may or may not be added during processing to increase the protein content.

1.2.4 Other Feeds

The category "other" includes the remaining industries in the source category, which account for 15 percent of the total byproduct animal feed production. Dog, cat and other pet food (dried only) accounts for 2.4 $x10^6$ Mg (2.6 $x10^6$ ton), or 7 percent, of the total dried animal feed production.[6] Grains, oilseed meals, and animal proteins are mixed, cooked, extruded as pellets, and dried in the production of dry animal feed in this industry.

Alfalfa dehydrators, the only segment of SIC 2048 that uses dryers in the production of animal feed, account for 1.1 $x10^6$ Mg (1.2 $x10^6$ tons) or 3.5 percent, of total dried animal feed production.[3] Alfalfa is mowed in the field approximately four times during the growing season and is then dehydrated in a dryer prior to being pelletized and sold as an animal feed.

The beet sugar industry produces 1.3 $x10^6$ Mg (1.4 $x10^6$ tons) of dried beet pulp, which accounts for 4 percent of the total dried animal feed production.[7] The beets are sliced and processed to remove the sugar, and the remaining beet pulp is then dried to produce animal feed.

1.3 INDUSTRY GROWTH AND EMISSIONS

As shown in Table 1-1, some growth in production capacity is forecast through 1985 for six of the eight industries in this source category. Wet corn milling is projected to have an annual growth rate of 7 percent through 1985, and it is estimated that in 1985 there will be the equivalent of 103 new/modified/reconstructed dryers with production of 2.2 $x10^6$ Mg (2.6 $x10^6$ tons) of animal feed per year. Four industry segments, soybean oil mills; dog, cat, and other pet food; distilled, rectified and blended liquors; and animal and marine fats and oils are projected to have annual growth rates of 5 percent through 1985. It is estimated that in 1985 there will be the equivalent of 56, 24, 16, and 20 new/modified/reconstructed dryers respectively in these industries, with production of 6.3 $x10^6$ Mg (7.0 $x10^6$ tons), 0.63 $x10^6$ Mg (0.70 $x10^6$ tons), 0.18 $x10^6$ Mg (0.2 $x10^6$ tons) and 0.22 $x10^6$ Mg (0.24 $x10^6$ tons) of animal feed per year. An annual growth rate of 2 percent is projected for alfalfa dehydrators in the period 1980 to 1985, and it is estimated that in 1985 there will be the equivalent of 22 new/modified/reconstructed dryers with production of 0.2 $x10^6$ Mg (0.22 tons) of animal feed per year. No growth is projected for the remaining two industry segments through 1985. It is projected that the equivalent of 18 and 5 new/modified/reconstructed dryers will be needed in 1985 to maintain current production in these two industries. These dryers will account for 1.2 $x10^6$ Mg (0.23 x10 tons) and 0.05 $x10^6$ Mg (0.06 $x10^6$ tons) respectively of animal feed per year.

The primary emissions from animal feed dryers are particulate matter, and, in the case of direct-fired dryers, the products of combustion. Particulate matter emissions were the focus of this survey. In most cases, the particulate matter emissions represent valuable product ($276 to $386 per Mg, [$250 to $350 per ton]), and industry practice is to minimize product loss by using product recovery devices with the dryer.[8] In addition to achieving product recovery, these devices also help the plants to meet State Implementation Plans (SIP). Where additional emission control is needed, mechanical collectors or wet centrifugal collectors are used. Wet collectors are generally the more efficient

control devices, but they also have potential for creating a wastewater disposal problem. Material collected by dry collectors can be recycled to the process; however, such recycling is generally not feasible with wet collection systems. In some instances, exhaust gas recycle systems are being used to conserve energy and reduce particulate matter emissions. No test data were found to evaluate the effectiveness of exhaust gas recycling.

Table 1-1 also contains estimates of annual emissions from new, modified or reconstructed facilities in 1985 for each industry segment. These estimates were developed to assess the magnitude of particulate matter emissions from animal feed dryers. Therefore, the estimates were calculated using the upper range of emission factors developed from test data and other information. These emission estimates show soybean oil mills have the greatest emissions of particulate matter in the source category; i.e., 4,763 Mg/yr (5,250 tons/yr) if all dryers are uncontrolled and 1,905 Mg/yr (1,905 tons/yr) if all dryers are equipped with pollution control equipment. Particulate matter emissions from the remaining industry segments of the source category are estimated to range from 1,140 Mg/yr (1,256 tons/yr) and 794 Mg (875 tons/yr) for uncontrolled and controlled wet corn milling to 65 Mg/yr (72 tons/yr) and 14 Mg/yr (15 tons/yr) for uncontrolled and controlled animal and marine fats and oils.

EPA Reference Method 5 (40 CFR 60, Appendix A [Revised July 1, 1979]) is the recommended procedure for measurement of the particulate matter content of animal feed dryer exhaust gases. Depending on the moisture content of the exhaust gas, the sample train may need to be modified to prevent blinding of the filter.

The SIP's for 47 States in which animal feed dryers are located require the control of particulate matter emissions. The SIP's are more stringent for new plants than for existing plants. New Jersey, Pennsylvania, and the South Coast Air Quality Management District have the lowest particulate matter emission limits; Arkansas, Illinois, and Indiana have developed particulate matter emission limits specific to animal feed drying plants.

1.4 REFERENCES

1. Feedstuffs, The Weekly Newspaper for Agribusiness. 53(30):18. July 23, 1981.

2. Current Industrial Reports: Fats and Oils--Oilseed Crushings. U.S. Department of Commerce. Washington, D.C. June 1981.

3. Current Industrial Reports: Grain Mill Products. U.S. Department of Commerce. Washington, D.C. June 1980.

4. Current Industrial Reports: Beverages. U.S. Department of Commerce. Washington, D.C. June 1980.

5. Current Industrial Reports: Animal and Marine Fats and Oils. U.S. Department of Commerce. Washington, D.C. July 1980.

6. State of the Industry. Pet Food Industry. Morris, Illinois. May-June 1981. p. 8.

7. U.S. Beet Sugar Association. American Beet Sugar Companies 1980-1981 Director. Washington, D.C. July 1980. p. 3-5.

8. U.S. Environmental Protection Agency. Office of Air Quality Planning and Standards. Source Category Survey: Starch Manufacturing Industry. EPA-450/3-80-040. Research Triangle Park, N.C. November 1980. p. 3-1.

2. INTRODUCTION

The Administrator of the U.S. Environmental Protection Agency is directed under Section 111 of the Clean Air Act to establish air pollution standards for new sources and in so doing has authority to:

1. Identify those categories of stationary emission sources that contribute significantly to air pollution and could be reasonably anticipated to endanger the public health and welfare;

2. Distinquish classes, types, and sizes within categories for the purpose of establishing standards; and

3. Establish standards of performance for stationary sources which reflect the emission reduction achievable through application of the best system of continuous emission reduction, taking into consideration the cost, energy, and environmental effects associated with the emission reduction.

The objective of this survey was to assess whether new source performance standards (NSPS) should be developed for dryers used in the production of animal feeds. Dryers covered by other new source performance standards (such as the grain dryers NSPS) were excluded from this study. The SIC codes and products which were examined during the survey are listed in Table 2-1. Information about processes, emissions, growth, and control equipment was gathered as follows:

1. Process and emission data were collected from literature searches, EPA regional offices, State and local air pollution control agencies, trade associations, equipment vendors, and plant visits.

2. Representatives of industry, government agencies, trade associations, and equipment vendors were contacted to obtain industry growth information. Additional information on growth was obtained from articles in trade journals and other publications.

TABLE 2-1. INDUSTRIES AND PRODUCTS

SIC code/industry classification		Primary products for use as animal feed
2046	Wet corn milling	Gluten feed, gluten meal
2047	Dog, cat, and other pet food	Dried pet food
2048	Prepared feeds and feed ingredients for animals and fowls, NEC	Alfalfa meal and pellets
2063	Beet sugar	Dried molasses beet pulp
2075	Soybean oil mills	Soybean cake and meal
2077	Animal and marine fats and oils	Fish meal, feather meal
2082	Malt beverages	Brewers dried spent grains
2085	Distilled, rectified and blended liquors	Distillers dried spent grains

3. Visits were made to the 11 plants listed in Table 2-2. An additional visit was made to an equipment manufacturer--Aeroglide Corporation, Raleigh, North Carolina.

Animal feed dryers are used to reduce the moisture content and sometimes to cool product prior to further processing, storage, and sale as an animal feed. Numerous types of dryers are available for drying animal feed ingredients: the direct-fired rotary, steam-tube rotary, tunnel or conveyor, flash, and ring dryers. The type of dryer used depends on the moisture content of the product entering the dryer and other factors, including the quantity of material to be processed, physical and chemical properties of the material to be dried, and site considerations.

In many instances, product recovery devices (i.e., primary cyclone collectors or discharge housings) are used with animal feed dryers. Therefore, unless otherwise noted, the pollution control equipment referred to in this report is any device used after a product recovery device to reduce particulate matter emissions. "Uncontrolled emissions" refers to the emissions measured after the product recovery device.

The industries that use animal feed dryers are described in subsequent sections of this report in terms of production capacity; projections of construction of new, reconstructed, and modified facilities; and production processes. Included are descriptions of emissions, emissions test data, emission control systems, State and local air pollution control regulations, and methods for emissions sampling and analysis.

TABLE 2-2. LIST OF PLANTS VISITED

Industry classification	Plant name	Location	Type of animal feed produced
Wet corn milling (SIC 2046)	American Maize Products Corp.	Hammond, Ind.	Gluten feed, gluten meal
	Henkel, Corp.	Keokuk, Iowa	Gluten feed meal
Dog, cat, and other pet food (SIC 2047)	Allen Products Company, Inc.	Allentown, Pa.	Dried pet food
	Doane Products	Joplin, Mo.	Dried pet food
Prepared foods and feed ingredients, NEC (SIC 2048)	Central Alfalfa, Inc.	Lexington, Nebr.	Alfalfa pellets
	Platte Valley Products, Inc.	Lexington, Nebr.	Alfalfa pellets
Soybean oil mills (SIC 2075)	Planters Oil Mill	Rocky Mount, N.C.	Soybean meal
	Ralston Purina Company	Raleigh, N.C.	Soybean meal
Animal and marine fats and oils (SIC 2077)	Standard Products Corp.	Southport, N.C.	Fish meal
	North Georgia Rendering	Cummings, Ga.	Feather meal
Malt beverages (SIC 2082)	Joseph Schlitz Brewing Co.	Winston-Salem, N.C.	Brewers dried spent grains

3. SURVEY CONCLUSIONS

3.1 INDUSTRY GROWTH

Table 3-1 summarizes information on industry growth within the source category. These growth estimates were derived from straight line projections of historical production data and information obtained from industry contacts. The two largest industries, soybean oil mills and wet corn milling, are expected to grow at annual rates of 5 and 7 percent, respectively. An increase in the supply of soybeans or in the demand for soybean meal may cause this industry to grow at a slightly faster rate. Similarly, an increase in the demand for high fructose corn syrup (HFCS) by the soft drink industry or an increase in the production of alcohol from corn could cause the wet corn milling industry to grow at a faster rate.

The trend in alfalfa dryer replacements toward larger dryers may reduce the number of plants in operation by 1985. Dog, cat, and other pet foods; distilled liquor; and the animal and marine fats and oils industries are all expected to grow at 5 percent per year.

No growth is projected in the beet sugar and malt beverages industries. The number of plants in the beet sugar industry probably will decline from 1980 to 1985.

3.2 AVAILABILITY OF CONTROL TECHNOLOGY

Technology for the control of particulate matter emissions from animal feed dryers is readily available. The most common device associated with dryers is the cyclone, which is used to separate entrained product from the emission gas stream. In many cases, the cyclone collector is sufficient to control emissions to levels required by SIP's. Additional control can be achieved through the use of additional cyclones, multiclones,

TABLE 3-1. SOURCE CATEGORY GROWTH PROJECTIONS[a]

Industry segment	Estimated annual growth, 1980-1985 percent	New/modified/reconstructed facilities, 1985			
		Plants	Dryers	Production 10^3 Mg/yr	Production 10^3 tons/yr
Soybean oil mills	5	0	56	6,350	7,000
Wet corn milling	7	19	103	3,279	2,500
Alfalfa dehydrators	2	0	22	204	225
Beet sugar	0	0	18	208	230
Dog, cat, and other pet foods	5	8	24	735	700
Distilled liquor	5	8	16	181	200
Malt beverages	0	0	5	54	60
Animal and marine fats and oils	5	10	20	218	240

[a]MRI estimate.

and other dry mechanical systems. With these secondary systems, emission control is the primary function, but product is also recovered. Better controlled dryers have some form of wet scrubber as the final control device. With direct-fired rotary dryers, "skimming" is widely practiced to return a portion of the emission gas stream to the dryer inlet. This recirculation reduces energy consumption and may reduce particulate matter emissions.

Technology for odor control is also available, and application was observed in two plant visits. One plant used packed-bed scrubbers with strong oxidants. The other plant used incineration as for odor control but retained a packed-bed scrubber as an alternative system.

3.3 SIGNIFICANT EMISSION SOURCES

An individual animal feed dryer with an associated product recovery device is the facility which would be affected by an NSPS for this source category. Maximum estimated uncontrolled emissions from an affected facility vary from about 20 to slightly less than 100 tons/yr. Therefore, this source category is not classified as a major source of emissions.

3.4 AVAILABILITY OF EMISSION DATA

The majority of the test data on animal feed dryers is from dryers used in gluten feed and meal, alfalfa meal, and beet sugar meal production. Eighty percent of the test data is for emissions after a product recovery cyclone. Insufficient data are available to correlate operational characteristics of the dryers or the physical properties of the product with emissions.

3.5 APPLICABLE METHODS FOR SAMPLING AND ANALYSIS

EPA Reference Method 5 is the procedure generally used for measuring particulate matter emissions in this source category. For the industry segments with high moisture content exhaust gases, some modifications to the Method 5 sample train will be required to prevent blinding of the sample filter.

In applying EPA Reference Method 5 the State of Iowa includes both the front and back half catches of the sampling train in determining the weight of particulate matter emissions. The emission limitations in Iowa

are adjusted to consider the contribution of the condensable particulate matter.

4. DESCRIPTION OF INDUSTRIES

This chapter describes the source category, animal feed dryers, and their applications. A generic description of dryers is presented in Section 4.1, and a discussion of the major industries which use animal feed dryers is presented in subsequent sections.

4.1 ANIMAL FEED DRYERS DESCRIPTION

Drying is the process of reducing the moisture content of a given material to the desired level by thermal means. The type of dryer which is used in an industry will depend on various factors including the following:[1]

1. Physical properties of the feed material and dried product;
2. Drying characteristics of the product;
3. Specification of the dried product;
4. Estimated product losses both as dust and, where solvents are present, solvent losses;
5. Site considerations, including space and height available;
6. Energy availability; and
7. Emission regulations.

Dryers typically used in industrial drying operations may be classified as direct or indirect depending on the heating method. With direct-fired dryers, heated air and combustion gases flow through the dryer in direct-contact with the material being dried. Thus, emissions from direct fired dryers consist of the products of combustion as well as entrained particulate matter. With indirect dryers, heat is supplied indirectly by conduction. Examples of common indirect heating methods are steam tubes inside dryers, combustion gases heating the outside of dryers, and electrical heating elements. In indirect dryers, air flow through the

dryer is maintained to assist in the removal of water and other vapors. Emissions from indirect dryers consist of entrained particulate matter.

The most common types of dryers used in animal feed manufacturing are direct-fired rotary, steam-tube rotary, conveyor (tunnel), and pneumatic conveyor (i.e., ring and flash) dryers. In direct-fired rotary dryers, the material to be dried is fed into a rotating drum downstream from the introduction of combustion gases from the fire box and moves either concurrent or countercurrent to the flow of combustion gases. The material is tumbled in a rotating drum and may make a single or triple pass through the dryer.

In a steam-tube rotary dryer, the material is tumbled through a long rotating cylinder ringed with steam tubes. These dryers may be operated with natural or induced draft.

In conveyor or tunnel dryers, material is supported on a conveying screen that moves continuously. The conveyor may be single-pass or double-pass, depending on the tolerance of the material to the agitation. Heated air or hot gases (depending on whether a direct or indirect heat source is used) from below or above the conveyor pass through the material to effect drying.

In pneumatic conveyor dryers, moist product is dispersed into a heated gas stream. Moisture is removed as entrained product is carried upward in a conveying duct. The dried product is then separated from the gas stream by gravitational and centrifugal forces.

4.2 SOURCE CATEGORY

Dryers are used in the production of animal feeds in the following industries:

1. Soybean Oil Mills;
2. Wet Corn Milling;
3. Dog, Cat and Other Pet Foods;
4. Beet Sugar;
5. Alfalfa Dehydrators;
6. Animal and Marine Fats and Oils;
7. Distilled Liquor; and
8. Malt Beverages.

The following sections present discussions of these industries, their dryer applications, and emissions. Table 4-1 provides a list of individuals and firms that are knowledgeable in the source category and have been helpful in this study.

4.2.1 Soybean Oil Mills

4.2.1.1 Introduction. Soybean Oil Mills (SIC 2075) process soybeans to produce soybean oil and residual cake and meal that are dried and used as an animal feed. Currently, there are 121 oil mills operating in the U.S. with the capacity to produce 22.7 x 10^6 Mg/yr (25 x 10^6 tons/yr) of animal feed.[2,3] Oil mills range in size from 544 to 6.8 x 10^5 Mg/yr (600 to 7.5 x 10^5 tons/yr) of animal feed. A typical new plant could be expected to produce 3.2 x 10^5 Mg/yr (3.5 x 10^5 tons/yr) of animal feed using three dryers.[4] In 1977, 16.8 x 10^6 Mg (18.5 x 10^6 tons) of animal feed were produced with a value of $3,735 million.[2] From 1972 to 1979 the production of animal feed grew at a 5 percent annual rate; this rate of growth is expected to continue through 1985.[2,3]

Soybeans are grown over the same geographical range as corn. States with significant soybean acreage include Arkansas, Delaware, Illinois, Indiana, Iowa, Louisiana, Maryland, Michigan, Minnesota, Mississippi, Missouri, North Carolina, Ohio, South Carolina, Virginia and Wisconsin. Presently soybean meal supplies most of the demand for high protein animal feed. Competition from gluten feed and meal and fish meal is important because of the substitutability of the products and the effects of marginal pricing on supply.

Appendix A, Table A-1, lists the companies which operate soybean oil mills.

4.2.1.2 Process Description. Oil is extracted from the beans by expeller or rotary screw pressing, batch-type hydraulic pressing, or solvent extraction. Each bushel (27.2 kg [60 lb]) of soybeans yields about 5 kg (11 lb) of oil and 21 kg (47 lb) of soybean meal with 0.9 kg (2 lb) normally lost in processing.[5] Most U.S. soybeans are processed by the hexane extraction method in a continuous process. The subsequent discussion will pertain only to the solvent extraction process, since the mechanical extraction process produces soybean meal without the use of dryers.

TABLE 4-1. LIST OF CONTACTS

Affiliation	City, State	Contact	Telephone No.	Contact date	Comments
STATE/LOCAL CONTROL AGENCIES (BY STATE)					
Illinois EPA	Peoria, Ill.	Mr. Dean Hayden	(309) 691-2200, Ext. 244	08/14/81	
	Decatur, Ill.	Mr. Bill Spires	(217) 877-3976	08/14/81	
	Chicago, Ill.	Mr. Rico Vallejera, Mr. Fred Smith	(312) 345-9780	08/14/81	
	Springfield, Ill.	Ms. Joyce Salesskie	(217) 782-7326	08/17/81	
Hammond APC	Hammond, Ind.	Mr. Ronald Novak	(219) 853-6306	08/11/81	
Iowa Dept. Env. Quality	Des Moines, Iowa	Mr. Michael Hayward	(515) 281-8853	08/11/81	
Kans. Dept. of Health and Env.	Topeka, Kans.	Mr. Ray Buergin	(913) 862-9360	05/81	
Minnesota PCA	Roseville, Minn.	Mr. Jerry Liefert,	(612) 296-7272	08/11/81	
Missouri DNR	St. Louis, Mo.	Mr. Richard Knapp	(314) 622-3334	05/81	
Nebraska Dept. Env. Cont.	Lincoln, Nebr.	Mr. Dennis Burling	(402) 471-2186	05/81	
NC Div. Env. Mgrt.	Raleigh, N.C.	Mr. Thomas Allen	(919) 733-5473	07/01/81	
North Dakota Dept. Health	Bismark, N. Dak.	Mr. Robert King	(701) 224-2348	08/11/81	
		Mr. Dana Mont	(701) 224-2371	05/81	
Ohio Env. Protection Agency	Columbus, Ohio	Mr. William Juris	(614) 462-6285	05/81	
Pa. Bureau of AQC	Warnersville, Pa.	Mr. Jack McGrogan	(215) 678-0825	07/07/81	
	Bethlehem, Pa.	Mr. Tom DiLizaro	(215) 861-2074	07/07/81	
ANIMAL FEED DRYER FACILITIES					
Allen Products Co. (ALPO)	Allentown, Pa.	Mr. Jack McDaniel	(215) 395-3301	07/06/81	Plant manager
American Cyrstal Sugar	Moorhead, Minn.	Mr. Stan Bichsel	(218) 236-4400	07/14/81	Vice President-Research
		Mr. Ira Fordyce	(218) 236-4400	07/14/81	Manager, Env. Control
American Maize-Products	Hammond, Ind.	Mr. James Pavlovich	(219) 659-2000	07/14/81	Manager, Env. Affairs
	Decatur, Ala.	Mr. Herman Paasch	(205) 355-8815	07/14/81	Vice President
Archer Daniels Midland	Decatur, Ill.	Mr. Mark Calmes	(217) 424-5752	07/29/81	Safety Department
Central Alfalfa, Inc.	Lexington, Neb.	Mr. George Pfister	(308) 324-4631	07/20/81	Owner
Doane Products, Inc.	Joplin, Mo.	Mr. Tom Weinkauf	(417) 624-6166	07/13/81	Vice Pres.--Production
Grain Processing Corp.	Muscatine, Iowa	Mr. Ed Bartlett	(319) 264-4253	07/15/81	Manager, Env. Control
Henkel Company	Keokuk, Iowa	Mr. Kenneth Smick	(319) 524-2323	07/16/81	Plant Engineer
		Mr. David Clark	(319) 524-2323	07/16/81	Plant Manager
Monitor Sugar Co.	Bay City, Mich.	Mr. Ulrich Hillmer	(517) 686-0161	07/14/81	Vice President--Operations
North Georgia Rendering Co.	Cumming, Ga.	Mr. Thomas Bagwell	(404) 887-6148	07/01/81	
Planters Oil Mill, Inc.	Rocky Mount, N.C.	Mr. Bill Adcock	(919) 442-0193	07/13/81	Vice President, General Mgr.
		Mr. Dave Mitkos	(919) 442-0193	07/13/81	Plant Manager
Platte Valley Products	Lexington, Neb.	Mr. James Burnett	(308) 324-6622	07/20/81	Partner
Ralston-Purina Co.	Raleigh, N.C.	Mr. D. T. Fink	(919) 828-4491	07/13/81	Manager
	St. Louis, Mo.	Mr. Ron Moeller	(314) 982-3276	07/13/81	Soybean Division

(continued)

TABLE 4-1. (continued)

Affiliation	City, State	Contact	Telephone No.	Contact date	Comments
ANIMAL FEED DRYER FACILITIES (continued)					
Joseph Schlitz Brewing Co.	Winston-Salem, N.C.	Mr. Joe Kwolkoski	(919) 788-6710	07/13/81	Engineer
		Mr. James McEvoy	(919) 788-6710	07/13/81	Plant Manager
	Milwaukee, Wis.	Dr. James Bennett	(414) 224-6252	07/13/81	Director, Env. Affairs
A. E. Staley Mfg. Co.	Decatur, Ill	Dr. William Hagenback	(217) 423-4411	07/14/81	Director, Env. Science
		Mr. Jerry Allen			
Standard Products of N.C.	Southport, N.C.	Mr. Rick Hamric	(919) 457-6751	07/13/81	General Manager
DRYER MANUFACTURERS					
Bepex Corporation	Bridgetown, Mo.	Mr. Michael Potter	(314) 739-7971	06/04/81	
Davenport Machine and Foundry Company	Davenport, Iowa	Ms. Rosemary S. Bryan	(319) 322-6201	06/09/81	
Dederet Corporation	Chicago Heights, Ill.	Mr. Robert A. Hawkins	(312) 754-4690	07/10/81	
The Dupps Company	Germantown, Ohio	Mr. W. F. Schottelkotte	(513) 855-6555	09/16/81	Director of Engineering
Fostoria Industries	Fostoria, Ohio	Mr. Bill Etzinger	(419) 435-9201	07/01/81	
Heil Company	Milwaukee, Wis.	Mr. Donald Kaminski	(414) 647-3333	07/20/81	Manager
Louisville Drying Machinery	Lousivlle, Ky.	Mr. John D. Robertson	(502) 583-7646	06/01/81	
MEC Company	Neodesha, Kans.	Mr. Ralph Barbee	(316) 325-2673	05/26/81	
Moorhead Machinery and Boiler Company	Minneapolis, Minn.	Mr. C. H. Olsen	(612) 789-3541	06/02/81	
National Drying Machine	Philadelphia, Pa.	Mr. Harry Fergason	(215) 739-4414	07/01/81	
Proctor and Schwartz	Philadelphia, Pa.	Mr. Walter Trout	(215) 329-6400	07/01/81	
C. E. Raymond	St. Louis, Mo.	Mr. Ralph W. Rogers	(314) 381-1600	06/09/81	
Edward Renneborg and Sons	Baltimore, Md.	Mr. John H. Renneburg	(301) 732-1665	06/09/81	President
C. G. Sargents	Westford, Mass.	Mr. Jim Robinson	(617) 692-6371	07/06/81	
Stearns-Rogers	Denver, Colo.	Mr. W. O. Young	(303) 758-1122	09/03/81	
Wenger Manufacturing	Sabetha, Kans.	Mr. Darrel Grollmes	(913) 284-3133	05/05/81	
CONTROL EQUIPMENT MANUFACTURERS					
AGET Manufacturing Company	Adrian, Mich.	Mr. H. Olsauer	(517) 263-5781	05/22/81	President
KOCH Engineering Company	New York, N.Y.	Mr. Norman Hansson	(212) 682-5755	08/06/81	
W. B. Patterson Company, Inc.	N. Kansas City, Mo.	Mr. Ron Humbird	(816) 842-2790	07/22/81	
TRADE ASSOCIATIONS					
American Dehydrators Assn.	Mission, Kans.	Mr. Glen Poe	(913) 831-0600	07/10/81	
American Feed Mfg. Assn.	Arlington, Va.	Mr. Oakley Ray	(703) 524-0810	07/06/81	

(continued)

TABLE 4-1. (continued)

Affiliation	City, State	Contact	Telephone No.	Contact date	Comments
TRADE ASSOCIATIONS (continued)					
American Institute of Food Distribution	Fair Lawn, N.J.	Mr. Marion Salvemini	(201) 791-5570	06/30/81	
American Soybean Association	St. Louis, Mo.	Mr. Ken Lepley	(314) 432-1600	07/09/81	
Corn Refiners Association	Washington, D.C.	Mr. Brunner	(202) 331-1634	07/06/81	
Distilled Spirits Council of U.S.	Washington, D.C.	Mr. Sam Chilcote, Jr.	(202) 628-3544	07/10/81	
Distillers Feed Research Council		Dr. William Isgrig	(606) 371-1360	06/29/81	
Farmers and Mfg. Beer Sugar Association	Saginaw, Mich.	Mr. Perc Reeve	(517) 792-1531	06/30/81	
National Fisheries Institute	Washington, D.C.	Mr. Lee Weddig	(202) 857-1110	06/30/81	
National Food Processors Association	Washington, D.C.	Mr. Ray Altevogt Mr. Wally Rose	(202) 331-5900 (415) 843-9762	06/30/81 10/05/81	
National Grain and Feed Assn.	Washington, D.C.	Mr. Jim Maness	(202) 783-2024	06/29/81	
National Renderers Assn.	Des Plaines, Ill.	Mr. William Prokop	(312) 827-8151	07/01/81	
National Soybean Processors Association	Washington, D.C.	Mr. Sheldon Hauck	(202) 452-8040	07/09/81	
Processed Apples Institute	Atlanta, Ga.	Mr. Larry Davenport	(404) 252-3663	07/09/81	
U.S. Beet Sugar Association	Washington, D. C.	Mr. Van Olsen	(202) 296-4820	06/30/81	
U.S. Brewers Association	Washington, D. C.	Ms. Catherine Marshall	(202) 466-2400	06/30/81	

Figure 4-1 presents a schematic of the overall features of a soybean processing plant using solvent extraction.

Soybeans are shipped to the processing facility by rail, truck, or barge. Upon arrival at the plant, the beans are cleaned and dried to between 10.5 and 11 percent moisture in grain dryers.

After the cleaning and drying steps, the beans are prepared for flaking. The beans are first passed through cracking mills or rolls where each bean is broken into four to eight parts. The hulls and meat are then separated in dehulling equipment, which may utilize a combination of screens, aspiration, and gravity tables. The hulls are collected by a product recovery cyclone and/or fabric filter and then sent through a grinding step prior to being conveyed to storage. The meat is transferred from the dehulling-separation equipment to the conditioning equipment. The conditioner is typically a steam-tube rotary unit that heats the meat to 71° to 77°C (160° to 170°F).

From the conditioning equipment, the meat is conveyed to the flaking rolls and then to the extractors. In the extractor, the flaked beans are contacted with hexane at approximately 52°C (125°F). The oil-hexane mixture (miscella) produced in the extractor flows to a working storage tank and then to hexane recovery operations. Hexane is removed from the miscella by steam distillation in a stripping column or still. The hexane vapor is condensed and returned to the solvent working tank after removal of water.

Spent flakes from the extractor are carried by closed screw or drag conveyor through a desolventizer. Four types of desolventizers are in use: (1) desolventizer-toaster system, (2) steam-jacketed conveyor, (3) flash desolventizer, and (4) vapor desolventizer-deodorizer system. Solvent vapors released in this operation are condensed and returned to the solvent working tank.

From a desolventizer-toaster system, the meal is dried first in a steam-tube rotary dryer and then is cooled before being sent to a grinder and storage for sale as animal feed.

4.2.1.3 Emissions. Soybean meal dryers are a source of particulate matter emissions at soybean oil mills. A typical large plant, of the

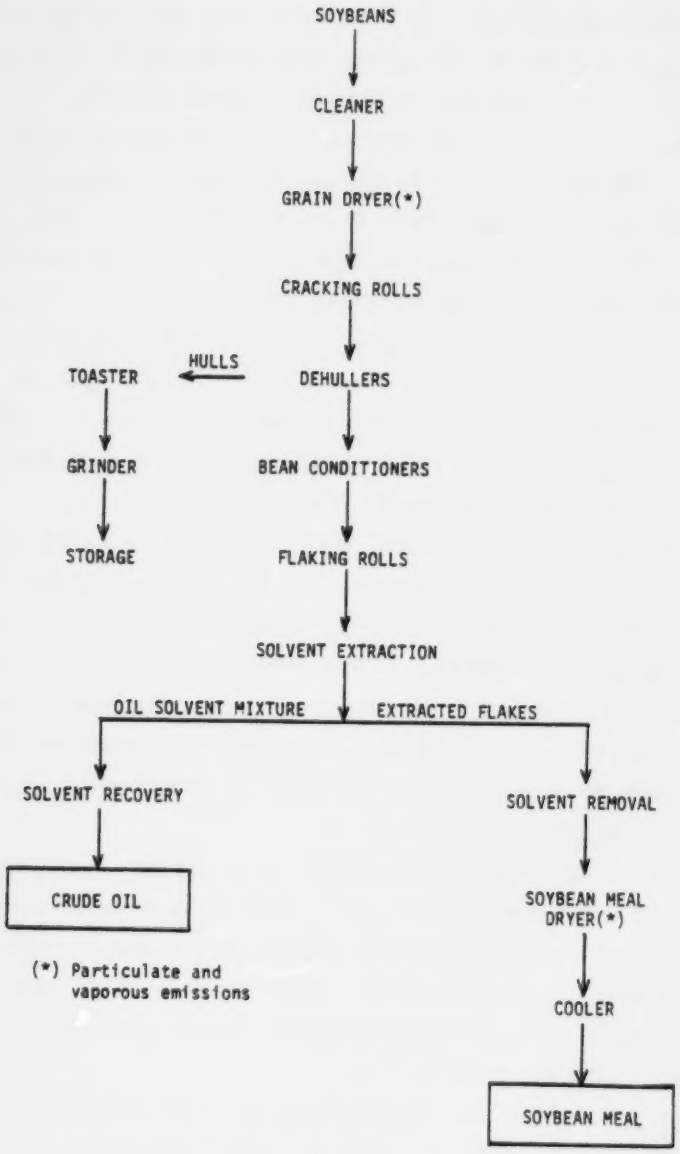


Figure 4-1. Soybean oil mill processing flow diagram.

type expected to be built to replace retired stock, will have two to three dryers, each capable of producing approximately 1.36×10^5 Mg/yr (1.5×10^5 tons/yr) of animal feed. Data received from the State of Illinois indicate uncontrolled emissions of 0.25 kg/Mg (0.5 lb/ton) were measured at one plant.[6] Published emission factors show uncontrolled emissions from soybean meal dryers are 0.75 kg/Mg (1.5 lb/ton).[7] It would be reasonable to conclude that on the average uncontrolled emission rates probably range from 0.25 kg/Mg to 0.75 kg/Mg (0.5 to 1.5 lb/kg). Using 0.25 kg/Mg (0.5 lb/ton), the estimated uncontrolled emissions from a new or replacement dryer would be 34 Mg/yr (38 tons/yr) of particulate matter. Using 0.75 kg/Mg (1.5 lb/ton), the uncontrolled emissions from a new or replacement dryer are estimated to be 84 Mg/yr (94 tons/yr) of particulate matter. The data received from the State of Illinois also show that controlled emissions range from 0.065 to 0.3 kg/Mg (0.13 to 0.6 lb/ton).[6] Using 0.065 kg/Mg (0.13 lb/ton), the estimated controlled emissions from a new or replacement dryer would be about 9 Mg/yr (10 tons/yr) of particulate matter.

4.2.2 Wet Corn Milling

The Wet Corn Milling (SIC 2046) category includes primarily plants that manufacture corn or milo (soybean grain) by a wet milling process into starch, syrup, oil, sugar, and gluten feed and meal. Also included are plants that manufacture starch from other vegetable sources (wheat, potato, etc.) by a wet milling process.

Currently, there are 46 plants in this category in the U.S. with the capacity to produce 3.1×10^6 Mg/yr (3.4×10^6 tons/yr) of animal feed.[8,9,10] Wet corn milling plants range in size from 5.4×10^4 to 2.9×10^5 Mg/yr (6×10^4 to 3.2×10^5 tons/yr) of animal feed. A typical new plant could be expected to produce 2.9×10^5 Mg/yr (3.2×10^5 tons/yr) of animal feed using eight dryers.[4] In 1977, 2.4×10^6 Mg/yr (2.7×10^6 tons) of animal feed were produced with a value of $352.9 million.[8] From 1972 to 1979 the production of animal feed grew at a 7 percent annual rate; this rate of growth is expected to continue through 1985.[8,9,10] The growth rate may increase to as much as 14 percent annually if demand increases for high fructose corn syrup (HFCS) or for commercially produced ethanol.[12]

Corn is grown principally in Illinois, Iowa, Indiana, Ohio, and Missouri. The majority of the wet corn milling operations are located in these States. With current milling practices each bushel of corn (25.4 kg [56 lb]) yields approximately 15 kg (34 lb) of starch, 5.9 kg (13 lb) of animal feed, and 0.9 kg (2 lb) of oil.[13,14]

Table A-2 lists the companies which operate starch manufacturing plants.

4.2.2.2 Process Description. A process flow diagram for production of animal feed ingredients from wet corn milling is given in Figure 4-2. The major feed ingredients produced are gluten feed and gluten meal. Steepwater concentrate and germ meal (as indicated in Figure 4-2) are also produced.

Shelled corn is cleaned by sifters and an air stream. The cleaned kernels are then soaked (steeped) for 30 to 50 hours in a warm water solution which contains sulfur dioxide. Steeping removes some of the soluble material, toughens the center of the kernel (germ) and softens the protein rich material (gluten).

The softened kernels pass to degermination mills, which macerate the fiber and hull without crushing the germ. The macerated kernels are sent to separators to remove the germ. Germ is washed, dried, and sold or is internally processed into corn oil or germ meal.

The remaining portions of the corn (including starch fiber [bran] and gluten) are finely ground and then washed through screens to remove the fiber. The fiber is combined with steepwater concentrate and chaff and dried to produce gluten feed. Gluten feed contains approximately 10 percent moisture and consists of material with approximately 21 percent protein content. The final product may be pressed into pellets before it is sold.

The remaining aqueous suspension (millstarch) is processed in centrifugal separators to separate the lighter gluten from the heavier starch material. The gluten fraction is dried and sold as gluten meal for animal feed (containing approximately 60 percent protein). The starch is (1) washed, dried, and sold to the food, paper, and textile industries; (2) further processed to modified starch products or dextrin; or (3) converted to syrup or sugar.

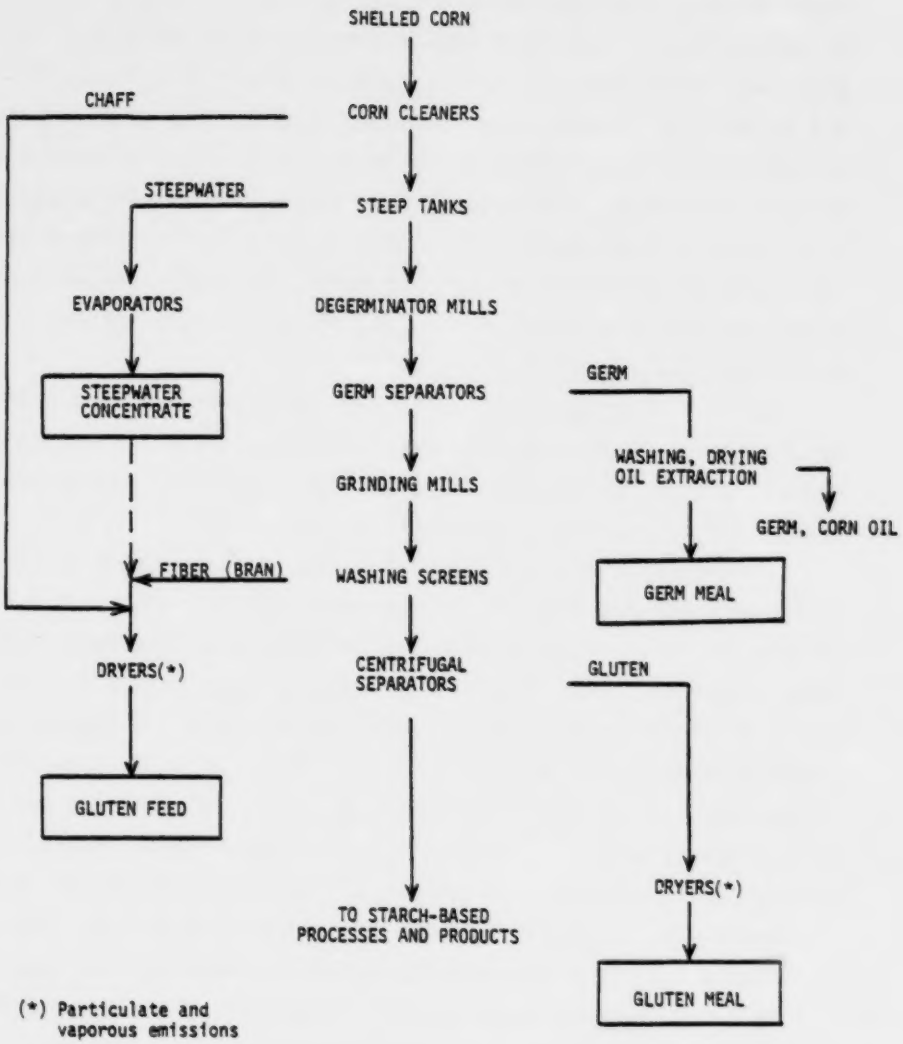


Figure 4-2. Wet corn milling flow diagram.

4.2.2.3 Emissions. Animal feed dryers are a source of particulate matter emissions at wet corn mills.[15] A typical large plant, of the type expected to be built to replace retired stock will have four to eight dryers, each capable of producing 3.6×10^4 Mg/yr (4.0×10^4 tons/yr) of animal feed. Test data indicate uncontrolled emissions for each dryer may range from 0.1 to 0.5 kg/Mg (0.2 to 1.0 lb/ton).[16,17] Using 0.5 kg/Mg (1.0 lb/ton), the estimated uncontrolled emissions from a new or replacement dryer would be 18 Mg/yr (20 tons/yr) of particulate matter. Available data suggest that controlled emissions may range from 0.15 kg/Mg to 0.35 Kg/Mg (0.3 to 0.7 lb/ton).[17,18] Using 0.15 kg/Mg (0.3 lb/ton), estimated controlled emissions from a new or replacement dryer would be 5.4 Mg/yr (6 tons/yr) of particulate matter.

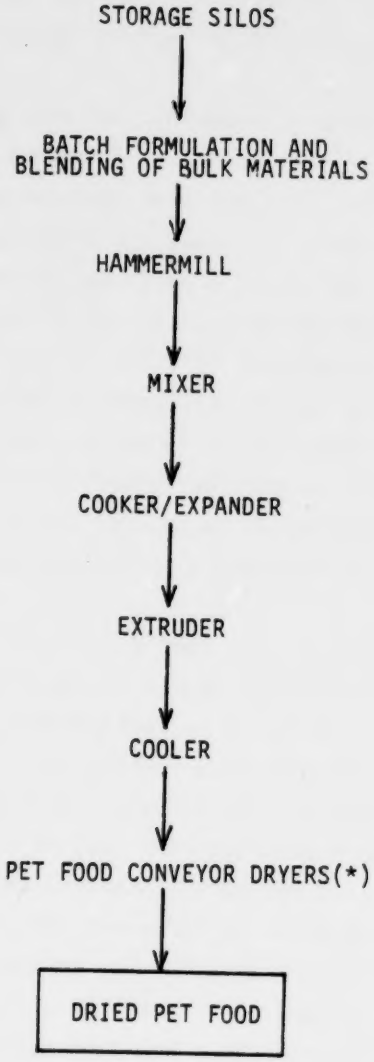
4.2.3 Dog, Cat, and Other Pet Food

4.2.3.1 Introduction. Dog, Cat, and Other Pet Food (SIC 2047) manufacturers process cereal, meat products, and other ingredients into canned, frozen, or dry animal feeds. Only dry food manufacturing involves the use of dryers and is included in this survey.

Currently, there are 272 plants operating in the U.S. that produce both "wet" and dry foods.[9] Current dry food production is 2.4×10^6 Mg/yr (2.6×10^6 tons/yr) accounting for 58 percent of the feed produced in this industry.[19] Pet food plants range in size from 4.5×10^4 to 9.1×10^4 Mg/yr (5.0×10^4 to 1.0×10^5 tons/yr). A typical new plant could be expected to produce 9.1×10^5 Mg/yr (1×10^5 tons/yr) using three dryers.[4] In 1977, 1.9×10^6 Mg (2.1×10^6 tons) of dry pet food were produced with a value of $1,208 million.[8] From 1972 to 1979, the production of dry pet food grew at a 3 to 5 percent annual rate; a 5 percent rate of growth is expected to continue through 1985.[8,19]

Table A-3 lists the companies which operate dry pet food plants.

4.2.3.2 Process Description. Figure 4-3 gives a representative process flow diagram of a dry pet food manufacturing process. Dried pet food is formulated from grains, soybeans, meat and meat by-products, tallow, vitamins, minerals, and other by-product meals. The typical production process consists of grinding and mixing, expanding in a cooker, pellet extruding, cooling, drying and cooling, and packaging. Grains and beans received in bulk (already dried to meet a moisture



(*) Particulate and vaporous emissions

Figure 4-3. Dry pet food manufacturing flow diagram.

specification) are stored in silos and then ground to desired particle size in hammermills. Vacuum collection systems are installed at transfer points in the process to reduce fugitive dust, recover product, and maintain cleanliness.

The expander/cooker-extruder-cooler unit produces pet food pellets with approximately 12 percent moisture content. These pellets are evenly distributed on the dryer oven conveyor where they make one or more passes before emerging cooled and dried to about 8 to 10 percent moisture content. Typical of dryers used in the industry is the tunnel dryer with either one or two passes that is sold in sizes ranging from 2.27×10^3 to 2.27×10^4 kg/h (4×10^3 to 4×10^4 lb/h). The heat source may be natural gas or oil burners, steam coils, electrical resistance elements, or waste heat. To increase the evaporation rate, dryers are equipped with blowers to provide controlled circulation. An air flow of about 9.4 m^3/s (20,000 acfm) is typical for a dryer of 9 Mg/h (10 tons/h) capacity. Dryers are equipped with cyclone collectors for product recovery.

4.2.3.3 Emissions. Pet food dryers are a source of particulate matter emissions at pet food manufacturing plants. A typical plant, of the type expected to be built to replace retired stock, will have two to three dryers, each capable of producing 4.5×10^4 Mg/yr (5×10^4 tons/yr) of animal feed. Uncontrolled emissions of 0.8 kg/Mg (1.6 lb/ton) have been estimated from a manufacturers test of a representative system.[20] Using this figure, the estimated uncontrolled emissions from a new or replacement dryer would be 36 Mg/yr (40 tons/yr) of particulate matter. According to manufacturer's test data, controlled emissions are 0.005 kg/Mg (0.01 lb/ton).[21] Using this figure, the estimated controlled emissions from a new or replacement dryer would be 0.23 Mg/yr (0.25 tons/yr) of particulate matter.

4.2.4 Beet Sugar

4.2.4.1 Introduction. Beet Sugar (SIC 2075) plants process beets to produce sugar; the residual beet pulp is dried and sold as an animal feed. Currently, there are 57 beet sugar plants operating in the U.S. with the capacity to produce 1.3×10^6 Mg/yr (1.4×10^6 tons/yr) of animal feeds.[22,23] Beet sugar plants range in size from 9×10^3 to

4.5×10^4 Mg/yr (1×10^4 to 5×10^4 tons/yr). A typical plant could be expected to produce 2.4×10^4 Mg/yr (2.6×10^4 tons/yr) of animal feed using two dryers.[4] In 1977, 1.27×10^6 Mg (1.4×10^6 tons) of animal feed were produced with a value of $106.9 million.[22] From 1972 to 1979 the production of animal feed remained essentially unchanged, varying plus or minus 1 percent annually.[22] No growth is projected through 1985, and negative growth is possible. The manufacture of beet sugar is a seasonal operation. In most of the U.S. the harvest period lasts from October until the end of November, by which time the harvest must be completed to avoid freezing of the beets in the ground. It is customary to build storage piles of beets and to continue factory operations for about two more months, resulting in an operating season of approximately 120 days. Table A-4 lists the companies which operate beet sugar plants.

4.2.4.2 Process Description. A representative flow diagram of a beet sugar processing operation is presented in Figure 4-4. Beets are weighed at the receiving station and undergo an initial cleaning that removes most of the dirt, rocks, and other debris. From here the beets are moved in water flumes to supply hoppers located over the beet slicing mechanism. Horizontal axis, rotating drum slicers are used to slice the beets into pieces 2 to 3 millimeters (mm) (0.08 to 0.12 in.) thick and up to 15 centimeters (cm) (5.9 in.) long. Next, the sugar is extracted from the beet slices in a diffuser. In a typical diffuser, the sliced beets travel up a covered sloping trough countercurrent to a stream of hot water. The raw diffusion juice leaving the lower end of the diffuser is screened to remove small pieces of sugar beet. The pulp leaves the diffuser with a water content of about 95 percent and is pressed in screw-type presses until it contains approximately 75 to 80 percent moisture. The water pressed out of the pulp contains some sucrose and is returned to the diffuser. The pressed pulp is enriched by the addition of molasses. This enriched pulp is dried in direct-fired rotary dryers (fired by natural gas, fuel oil, lignite or coal) to a final moisture content of 6 to 10 percent and is cooled and stored for sale as animal feed. At the discharge end of the dryer drum, the product enters a large discharge housing, causing it to drop out of the gas stream into a scroll. Hot gases rise to the top of the enlarged housing and pass

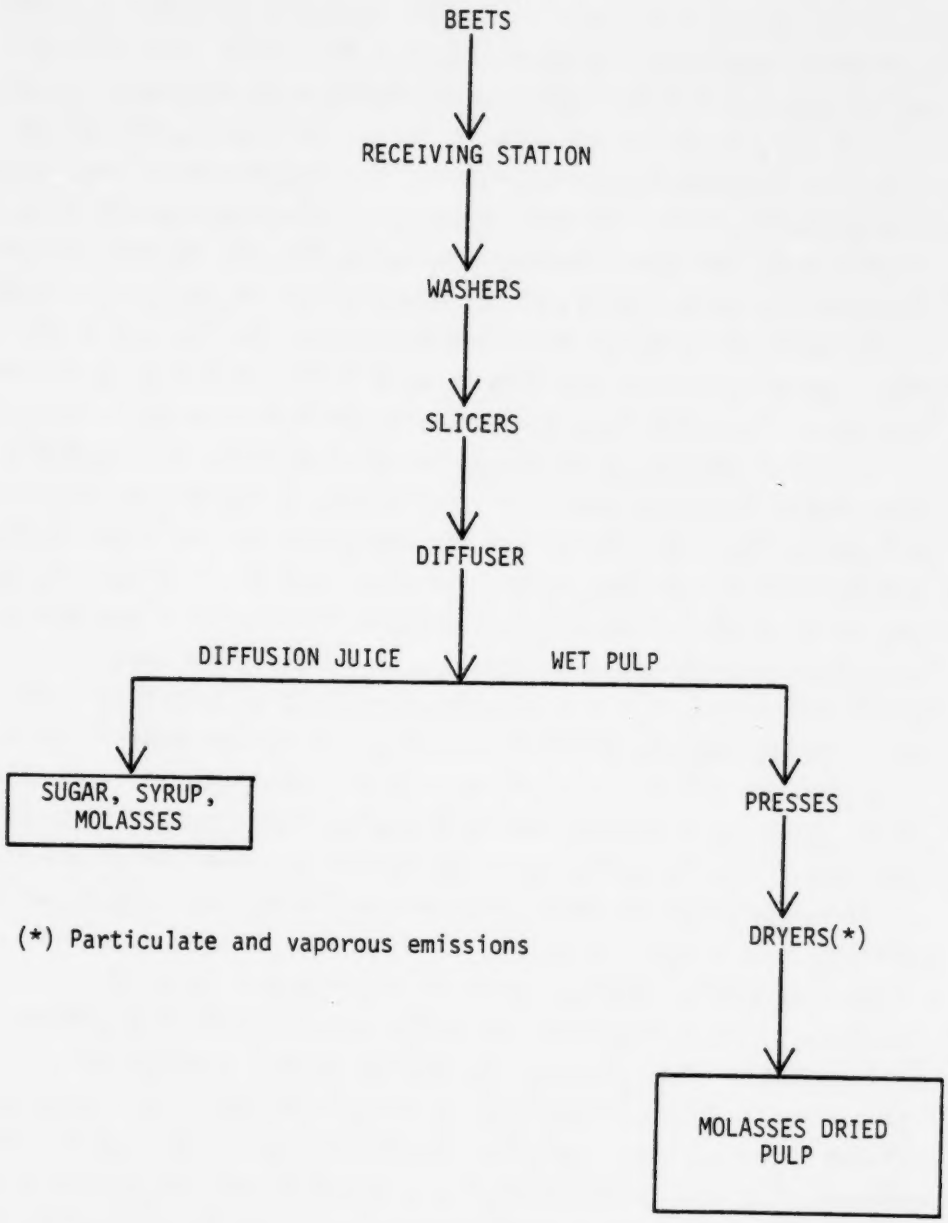


Figure 4-4. Beet sugar processing flow diagram.

through an induced draft fan to a cyclone for the control of particulate matter.

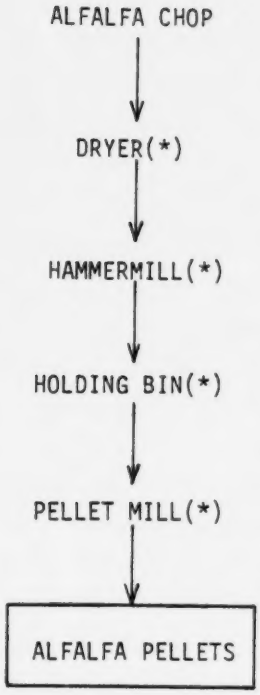
4.2.4.3 Emissions. Beet pulp dryers are a source of particulate matter emissions at beet sugar plants. A typical plant, of the type expected to be built to replace retired stock, will have two dryers, each capable of producing approximately 1.63×10^4 Mg/yr (1.8×10^4 tons/yr) of animal feed. Test data indicate uncontrolled emissions range from 0.75 to 3.0 kg/Mg (1.5 to 6.0 lb/ton).[24,25] Using 3.0 kg/Mg (6.0 lb/ton), the estimated uncontrolled emissions from a new or replacement dryer would be 49 Mg/yr (54 tons/yr) of particulate matter. Controlled emissions have been reported to range from 0.15 to 0.75 kg/Mg (0.3 to 1.5 lb/ton).[24,26] Using 0.15 kg/Mg (0.3 lb/ton) and 0.75 kg/Mg (1.5 lb/ton), the estimated controlled emissions from a new or replacement dryer would be 2.4 Mg/yr (2.7 tons/yr) and 12 Mg/yr (13.5 tons/yr), respectively.

4.2.5 Alfalfa Dehydrators

4.2.5.1 Introduction. Alfalfa Dehydrators (SIC 2048) dry "green" or "sun-cured" alfalfa for use as an animal feed. Currently, there are 180 alfalfa dehydrating plants operating in the U.S. with the capacity to produce 1.1×10^6 Mg/yr (1.2×10^6 tons/yr) of animal feed.[8,27] Alfalfa dehydrators range in size from 900 to 3.18×10^4 Mg/yr (1×10^3 to 3.5×10^4 tons/yr). A typical new plant could be expected to produce 1.9×10^4 Mg/yr (2.1×10^4 tons/yr) of alfalfa using two dryers.[4] In 1977, 1.1×10^6 Mg/yr (1.2×10^6 tons) of animal feed were produced with a value of $91 million.[8] From 1972 to 1979, the production of alfalfa has remained essentially stable.[8,9] A 2 percent rate of growth is expected through 1985.[28]

Alfalfa dehydrators are located throughout the country except in New England and the southeastern States. The center of the industry is in the Northern Plains States. Alfalfa dehydrators are typically located within 16 kilometers (10 miles) of the source of alfalfa. Table A-5 provides a list of alfalfa dehydrating plants.

4.2.5.2 Process Description. A representative flow diagram of an alfalfa dehydration plant is shown in Figure 4-5. Chopped alfalfa ("chops") is received at the plant and dried to 8 to 10 percent moisture content, usually in a direct-fired rotary drum dryer. Alfalfa dryers typically



(*) Particulate and vaporous emissions

Figure 4-5. Alfalfa pellet production flow diagram.

operate in the range of 982° to 1093°C (1800° to 2000°F). The temperature of exhaust gases from the dryer ranges from 121° to 160°C (250° to 320°F). Customarily, a cyclone is used to separate the product from the gases as they leave the dryer. The primary function of this cyclone is product recovery. The product recovered in the cyclone enters the hammermill, which reduces the dehydrated chops to meal. The meal then enters a negative pneumatic conveyor, which discharges into the meal collection bin. From the meal bin, the product may go to bagging, bulk storage, or pelletizing operations. Additional cyclone collectors are used to recover product and to reduce emissions from the hammermill, pellet mill, and associated collecting bins. The air streams from these secondary cyclones are usually ducted back to the primary cyclone collector.

4.2.5.3 Emissions. The dryers, hammermills, and pellet mills are sources of emissions at alfalfa dehydrating plants. A typical large plant, of the type expected to be built to replace retired stock, will have two dryers, each capable of producing approximately 9×10^3 Mg/yr (1×10^4 tons/yr). Test data indicate uncontrolled emissions range from 0.75 to 5.0 kg/Mg (1.5 to 10.0 lb/ton).[29,30] Using 5.0 kg/Mg (10.0 lb/ton), uncontrolled emissions from a new or replacement dryer would be 45 Mg/yr (50 tons/yr) of particulate matter. Controlled emissions range from 0.5 to 1.5 kg/Mg (1.0 to 3.0 lb/ton).[29] Using 0.5 kg/Mg (1.0 lb/ton), controlled emissions from a new or replacement dryer would be 4.5 Mg/yr (5 tons/yr) of particulate matter.

4.2.6 Animal and Marine Fats and Oil

4.2.6.1 Introduction. Animal and Marine Fats and Oils (SIC 2077) include plants that produce fish meal and feather meal, which are dried and used as animal feed. Currently, there are 67 companies that produce fish and feather meal in the U.S. with the capacity to produce 5.1×10^5 Mg/yr (5.6×10^5 tons/yr).[31,32] Fish and feather meal plants range in size from 7.3×10^3 to 1.27×10^4 Mg/yr (8×10^3 to 1.4×10^4 tons/yr) and 4.5×10^3 to 4.35×10^4 Mg/yr (5×10^3 to 4.8×10^4 tons/yr), respectively. A typical new fish meal plant could be expected to produce 1.63×10^4 Mg/yr (1.8×10^4 tons/yr) of animal feed using two to three dryers, while a

typical new feather meal plant could be expected to produce 1.36 x 10^4 Mg/yr (1.5 x 10^4 tons/yr) using two dryers.[4] In 1977, 2.56 x 10^5 Mg/yr (2.82 x 10^5 tons) of fish meal and 1.58 x 10^5 Mg/yr (1.74 x 10^5 tons) of feather meal were produced, with values of $82 and $39 million, respectively.[31,32] From 1972 to 1979, the production of fish meal grew at a 4 percent annual rate while the production of feather meal grew at a 3 percent annual rate.[32] Through 1985, fish meal production is expected to remain essentially stable while feather meal production is expected to grow at a 5 percent annual rate.[34,35]

Table A-6 lists the companies that operate fish meal and feather meal plants.

4.2.6.2.1 Process description--fish meal. A representative process flow diagram of a fish meal plant is given in Figure 4-6. Fish are pumped from boats into a measuring device, which is calibrated into a measure known as "one-thousand fish." One-thousand fish is equivalent to approximately 0.36 m^3 (22,000 $in.^3$) or 302 kg (665 lb). From here the fish are moved to a raw storage bin. Fish are moved from the raw storage bin via a screw conveyor into a live steam cooker. The cooker is a long horizontal section of the screw conveyor fitted with a cover. Cooking breaks the oil sacs and disintegrates the fish. From the live steam cooker the mixture is conveyed to dewatering presses, which reduce the fish meal to 42 to 50 percent moisture content. The water and oil pressed from the fish are processed through shaker screens to remove residual solids and are then centrifuged to separate the oil from water and fish solubles. The fish oil recovered is a final product. The water generated from the above process is known as "stick water" and is sent to an evaporator to concentrate the soluble and suspended solids. These fish solubles are added to the meal to produce a higher quality fish meal known as whole fish meal. From the dewatering presses, the fish meal enters rotary drum dryers where it is dried to approximately 10 percent moisture. The meal is recovered by product recovery cyclones on the end of the dryer and then conveyed to bulk storage. The exhaust gases are passed through an odor scrubber and then exhausted to the atmosphere.

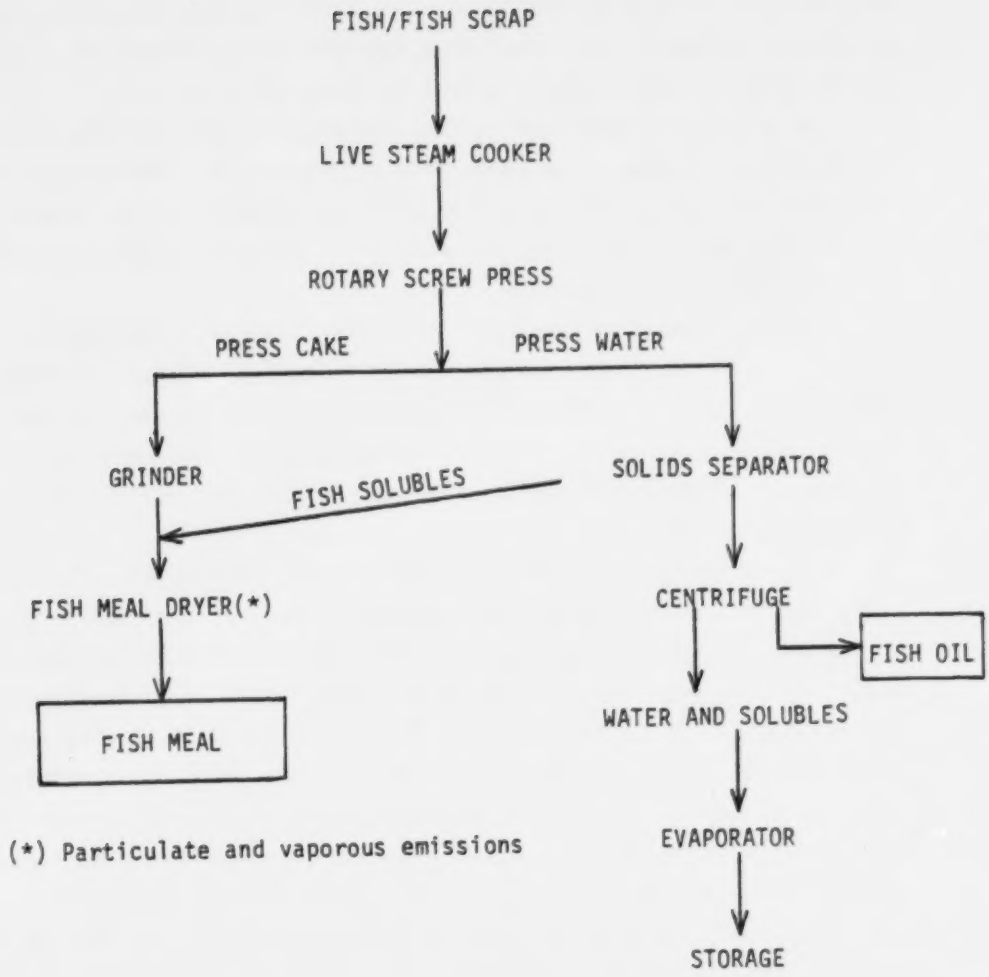


Figure 4-6. Fish meal production flow diagram.

4.2.6.2. Process description--feather meal. Feathers are received from chicken or turkey processing plants and are hydrolyzed to a meal in continuous or batch live steam or steam-tube pressure cookers. Blood may be added to the feathers before or after hydrolyzation.

The moisture content of the feather meal is reduced from approximately 70 percent to 7 percent in steam-tube rotary dryers. The feather meal then goes through a cooling and moisture adjustment process where dry or wet feather meal is added to the product as needed to adjust the final moisture content to 10 percent.

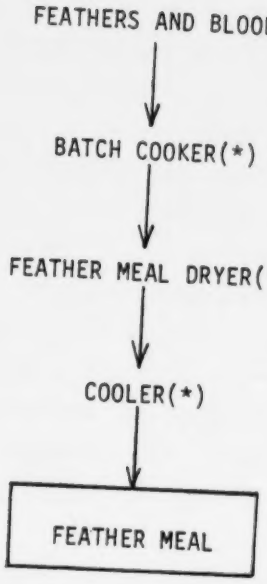
Exhaust gases from the pressure cookers, dryers, and coolers are collected and routed through cyclone collectors to remove suspended particulate matter and then are shunted to an odor control system. Feather meal is recovered from the cyclones and is returned to the process. A representative flow diagram of a feather meal plant is presented in Figure 4-7.

4.2.6.3 Emissions. The fish and feather meal dryers are sources of particulate matter emissions in these industries. A typical plant, of the type expected to be built to replace retired stock in the fish meal industry, will have two to three dryers, each capable of producing approximately 7.3×10^3 Mg/yr (8×10^3 tons/yr). No test data are available for either controlled or uncontrolled emissions from fish meal dryers. Using the factor of 0.005 kg/Mg (0.1 lb/ton) of uncontrolled emissions given in AP-42, a new or replacement dryer would be expected to emit less than 0.9 Mg/yr (1 ton/yr) of particulate matter.[36]

A typical plant, of the type expected to be built to replace retired stock in the feather meal industry, will have two to four dryers, each capable of producing approximately 1.45×10^4 Mg/yr (1.6×10^4 tons/yr) Test data indicate uncontrolled emissions of 0.3 kg/Mg (0.6 lb/ton).[37] Using 0.3 kg/Mg (0.6 lb/ton), the estimated uncontrolled emissions from a new or replacement dryer would be 4.4 Mg/yr (4.8 tons/yr) of particulate matter per dryer. No data are available to estimate controlled emission rates.

4.2.7 Distilled Liquor

4.2.7.1 Introduction. Distilled Liquors (SIC 2085) include plants that manufacture alcoholic liquor by distillation and rectification and



(*) Particulate and vaporous emissions

Figure 4-7. Feather meal production flow diagram.

that produce distillers' dried grain for sale as an animal feed. Currently, there are 93 distillers operating in the U.S. (not all of these produce dried grains) with the capacity to produce 4.45×10^5 Mg/yr (4.9×10^5 ton/yr) of animal feed.[38,39] A typical new plant could be expected to produce 2.27×10^4 Mg/yr (2.5×10^4 tons/yr) of dried grain using two dryers.[4] In 1977, 3.5×10^5 Mg/yr (3.87×10^5 tons) of dried grain were produced with a value of $42 million.[40] From 1972 to 1979, the production of animal feed grew at a 3 percent annual rate; a 5 percent annual rate of growth is expected through 1985.[40,41]

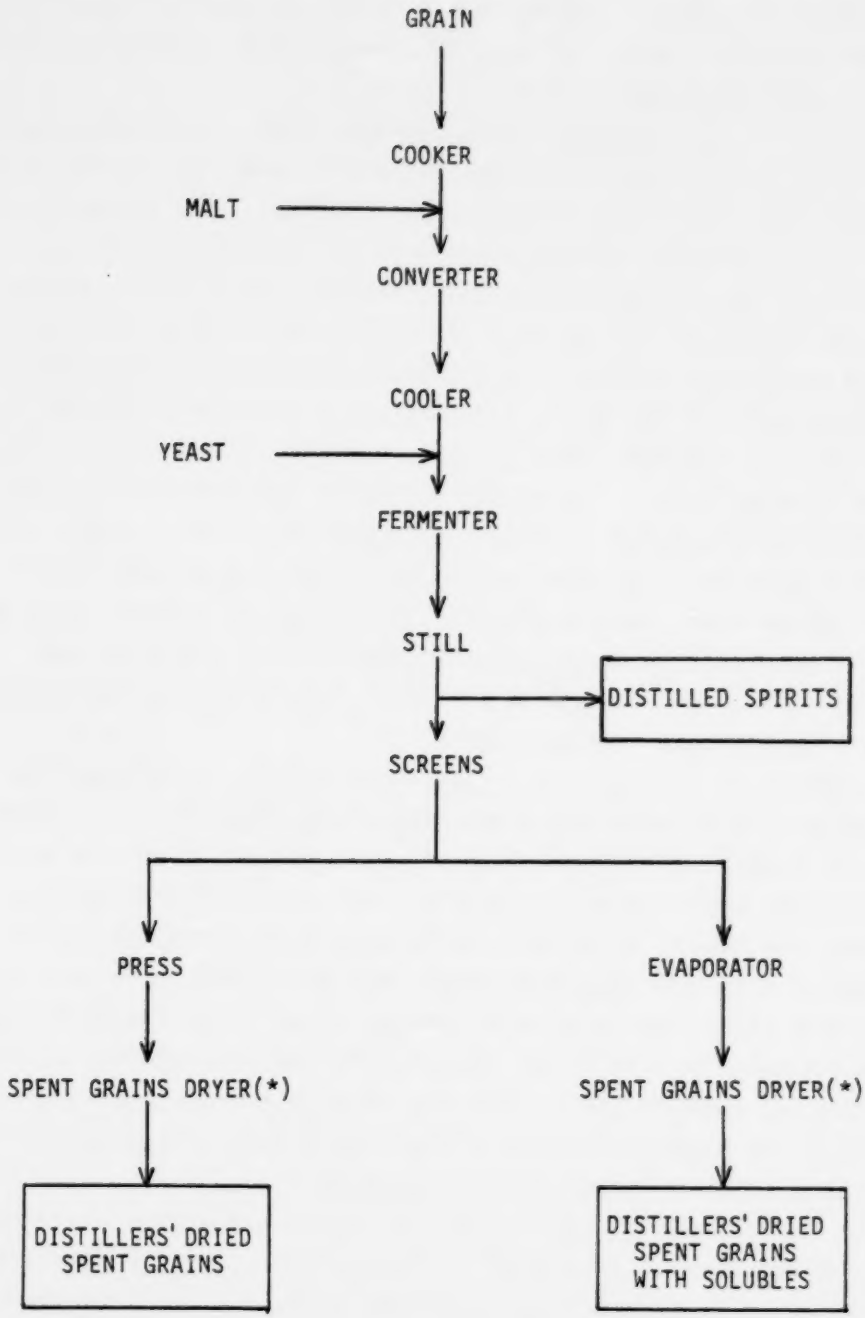
Table A-7 lists the companies which operate distilleries.

4.2.7.2 Process Description. Figure 4-8 shows a general process flow diagram of a distilled spirits plant. Cereal grains are ground, cooked to gelatinize the starch, cooled, and saccharified with malt. After settling for a period to permit saccharification, the mash is cooled to fermentation temperature, innoculated with yeast, and allowed to ferment from 3 to 5 days. The fermented mash is distilled, and the whole spent stillage is further processed to make distillers' dried grains.

First, the whole stillage is separated over screens with the coarse fraction being retained on the screens and the suspended solids and liquids passing through the screens. The coarse fraction is generally pressed for further removal of water before drying, and the liquids and suspended solids may be either centrifuged to remove suspended solids or evaporated to a syrup (30 to 40 percent solids).

In the production of distillers' dried grains with solubles, the screened and pressed fraction and syrup are mixed and dried, generally in steam-tube rotary dryers. In the production of distillers dried grains, only the coarse fraction is dried.

4.2.7.3. Emissions. Spent grain dryers are a source of particulate matter emissions at distilleries. A typical plant, of the type expected to be built to replace retired stock, will have two dryers, each capable of producing 1.36×10^4 Mg/yr (1.5×10^4 tons/yr) of dried grains. No test data were available for uncontrolled or controlled emissions. An emission factor of 2.5 kg/Mg (5.0 lb/ton) is given in AP-42 for uncontrolled



(*) Particulate and vaporous emissions

Figure 4-8. Distilled spirits production flow diagram.

emissions.[42] Using 2.5 kg/Mg (5.0 lb/ton), the expected uncontrolled emissions from a new or replacement dryer would be 34 Mg/yr (37.5 tons/yr).

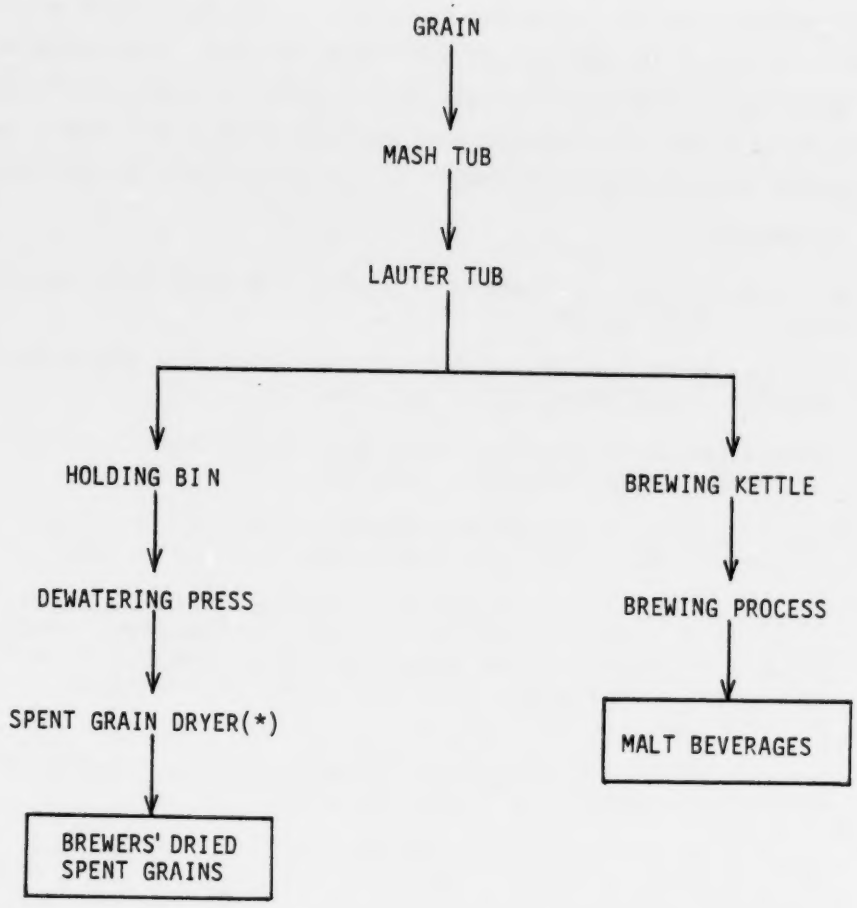
4.2.8 Malt Beverages

4.2.8.1 Introduction. Malt Beverages (SIC 2082) plants process cereal grains into malt beverages and dry the spent grain for use as an animal feed. Currently, there are 88 plants operating in the U.S. (not all produce brewers' dried grains) with the capacity to produce 3.63×10^5 Mg/yr (4×10^5 tons/yr) of animal feed.[43,44] Breweries range in size from 1.8×10^3 to 1.8×10^4 Mg/yr (2×10^3 to 2×10^4 tons/yr) of brewers' dried grains. A typical new plant could be expected to produce 1.8×10^4 Mg/yr (2×10^4 tons/yr) of brewer's dried grain using two dryers.[4] In 1977, 3.54×10^5 Mg (3.9×10^5 tons) of animal feed were produced with a value of $46 million.[40,44] From 1972 to 1979, the production of brewers' dried grain remained essentially stable; this stable level of production is expected to continue through 1985.[40,45]

At one time, general industry practice was to sell wet spent grains for feed or to bury or to flush the material into nearby streams. Many brewers still sell wet grains for feed. Table A-8 lists the companies which operate malt beverage plants.

4.2.8.2. Process Description. A representative process flow diagram of a malt beverage plant is given in Figure 4-9. The first step in the production of brewers' dried grains process is to move the spent grain from the spent grains holding hopper to the dewatering press surge hopper and then by screw conveyor to the rotary dewatering press. Three lines of materials leave the press: the water produced is sent to an effluent centrifuge, most of the pressed grain is sent to dryers, and the remaining portion of the pressed grain leaves along another conveyor to the wet spent grains storage bin. Some of the wet grains, along with some of the material from the effluent centrifuge, are mixed back into the dried grain to produce the raw feed material.

4.2.8.3. Emissions. Spent grain dryers are a source of particulate matter emissions at breweries. A typical large plant, of the type expected to be built to replace retired stock, will have two dryers, each capable of producing 1.1×10^4 Mg/yr (1.2×10^4 tons/yr). No test data are available for uncontrolled emissions. AP-42 lists an uncontrolled



(*) Particulate and vaporous emissions

Figure 4-9. Malt beverage production flow diagram.

emission factor of 2.5 kg/Mg (5.0 lb/ton).[42] Using 2.5 kg/Mg (5.0 lb/ton), the estimated uncontrolled emissions from a new or replacement dryer would be 27 Mg/yr (30 tons/yr) of particulate matter. Controlled emissions have been reported to be approximately 1.0 kg/Mg (2.0 lb/ton).[46] Using 1.0 kg/Mg (2.0 lb/ton), the estimated controlled emissions from a new or replacement dryer would be 11 Mg/yr (12 tons/yr) of particulate matter.

4.3 REFERENCES

1. Williams-Gardner, A. Industrial Drying. Houston, Gulf Publishing Company, 1977. p. 55.

2. 1977 Census of Manufacturers: Fats and Oils. U.S. Department of Commerce. Washington, D.C. July 1980.

3. Current Industrial Reports: Fats and Oils--Oilseed Crushings. U.S. Department of Commerce. Washington, D.C. June 1981.

4. Memo from Gold, B. D., Midwest Research Institute, to file. October 21, 1981. Fact sheets prepared for EPA briefing.

5. Shannon, L. J., R. W. Gerstle, P. G. Gorman, D. M. Epp, T. W. Devitt, and R. Amick. Emission Controls in the Grain and Feed Industry: Volume I--Engineering Cost Study. U.S. Environmental Protection Agency, Research Triangle Park, N.C. EPA-450/13-73-003a. December 1973. p. 88.

6. State of Illinois Environmental Protection Agency. Source Information Surveillance Report. Illinois. July 1981. p. 366.

7. Compilation of Air Pollutant Emission Factors. AP-42. U.S. Environmental Protection Agency. Office of Air Quality Planning and Standards. Research Triangle Park, N.C. 1973. Section 6.4 revised April 1977.

8. 1977 Census of Manufacturers: Grain Mill Products. U.S. Department of Commerce. Washington, D.C. August 1980.

9. Current Industrial Reports: Grain Mill Products. U.S. Department of Commerce. Washington, D.C. June 1980.

10. Corn Refiners Association, Incorporated. Corn Annual 1980. Washington, D.C. 1980. p. 32.

11. Snyder, D., ADM Foods Division of Archer Daniels Midland Company, reported in Milling. November 11, 1980. p. 47.

12. Reference 10. p. 21-31.

13. Kirk--Othmer. Encyclopedia of Chemical Technology: Volume 18. New York. John Wiley and Sons. 1969. p. 681.

14. Corn Refiners Association, Incorporated. Tapping the Treasure In Corn. Washington, D.C. 1976.

15. U.S. Environmental Protection Agency. Office of Air Quality Planning and Standards. Source Category Survey: Starch Manufacturing Industry. EPA-450/3-80-040. Research Triangle Park, N.C. November 1980. p. 3-2.

16. Curtis, T. C., and R. S. Robertson. Souce Sampling Studies at American Maize Products Company, Hammond, Indiana. No. 3 Heil Feed Dryer Cyclone. Nalco Chemical Company. Chicago, Illinois. June 1976.

17. Reference 5. p. 253-268.

18. Zapel, G. Report on the Particulate Emission Tests Conducted for Corn Sweetners Incorporated. Clean Air Engineering, Inc. Cedar Rapids, Iowa. October 1979. March 1980.

19. _____ State of the Industry. Pet Food Industry. Morris, Illinois. May-June 1981. p. 8.

20. Based on efficiency of control device reported in Reference 21.

21. Memo from Peckworth, D., to Telander, J. September 1, 1981. p. 30-37. Plant Visit--Allen Products Company, Incorporated.

22. 1977 Census of Manufacturers: Sugar and Confectionary Products. U.S. Department of Commerce. Washington, D.C. July 1980.

23. U.S. Beet Sugar Association. American Beet Sugar Companies 1980-1981 Directory. Washington, D.C. July 1980. p. 3-5.

24. Source Sampling Report: American Crystal Sugar Company. East Grand Forks, Minnesota. October 16, 17, 21, 1980.

25. Source Sampling Report: American Crystal Sugar Company. Drayton, North Dakota. September 27-28, 1977.

26. Source Sampling Report: Monitor Sugar Company. Bay City, Michigan. August 3, 1977.

27. American Dehydrators Association. Direct Members, Associate Members, Buyers Guide. Shawnee Mission, Kansas. 1981.

28. Memo from Mumma, C., to Telander, J. November 9, 1981. p. 2. Plant Visit--Platte Valley Products, Incorporated.

29. Reference 5. p. 169-202.

30. Source Sampling Report: National Alfalfa Dehydrating. Fargo, North Dakota. June 30, 1976 and July 1, 1976.

31. National Renderers Association. Render: The National Magazine of Rendering, Directory Issue. Riverside, California. April 1981.

32. 1977 Census of Manufacturers: Animal and Marine Fats and Oils. U.S. Department of Commerce. Washington, D.C. July 1980.

33. Current Fishery Statistics No. 8100. Fisheries of the United States, 1980. U.S. Department of Commerce. Washington, D.C. April 1981.

34. Memo from Peckworth, D., and B. Gold to Telander, J. August 21, 1981. Plant Visit--North Georgia Rendering Company.

35. Memo from Gold, Barry to Telander, J. August 14, 1981. Plant Visit--Standard Products Company Incorporated.

36. Compilation of Air Pollutant Emission Factors. AP-42. U.S. Environmental Protection Agency Office of Air Quality Planning and Standards. Research Triangle Park, N.C. 1973. Section 6.6.1 revised April 1977.

37. Source Sampling Report: Central Bi-Products. Long Prairie, Minnesota. 1978.

38. Distilled Spirits Council of the United States. Annual Statistical Review 1980. Washington, D.C. September 1981.

39. Current Industrial Reports: Beverages. U.S. Department of Commerce. Washington, D.C. 1979.

40. 1977 Census of Manufacturers: Beverages. U.S. Department of Commerce. Washington, D.C. July 1980.

41. Telecon. Sauer, M., MRI, with Isgrigg, W. Distillers Feed Research Council. October 20, 1981. Information on spent grain drying at distilleries.

42. Reference 36. Section 6.5.1 revised February 1980.

43. Breweries Authorized to Operate. Bureau of Alcohol, Tobacco and Firearms. July 1980. Through C. Marshall. U.S. Brewers Association, Inc.

44. Feedstuffs, the Weekly Newspaper for Agribusiness. 53(30):18. July 23, 1981.

45. Memo from Gold, B., to Telander, J. August 19, 1981. Plant Visit--Joseph Schlitz Brewing Company. p. 5.

46. Source Sampling Report: Joseph Schlitz Brewing Company. Winston Salem, N.C. September 6-7, 1978.

5. AIR EMISSIONS DEVELOPED IN SOURCE CATEGORY

5.1 PLANT AND PROCESS EMISSIONS

The principal air pollutant resulting from the drying of products used as animal feeds is particulate matter. Sulfur dioxide (SO_2), hexane, and odor emissions may also occur. In direct-fired dryers, the products of combustion are present in the emissions. Direct-fired, rotary drum dryers use natural gas, fuel oil, coal, or lignite as a fuel source. If fuels other than natural gas are used, SO_2 may be emitted. Furthermore, at soybean oil mills hexane may be emitted from the animal feed dryers. No data were found to quantify the presence of SO_2 and hexane emissions from dryers. Table 5-1 is a summary of particulate matter emission factors from typical dryers, which was developed from available test and permit data.

5.2 TOTAL NATIONAL EMISSIONS FROM SOURCE CATEGORY

Animal feed drying produces primarily particulate matter emissions but may also produce sulfur dioxide, odor, and other trace substances (i.e., hexane). Estimates of current national particulate matter emissions are given in Table 5-2. The annual production figures given in Table 5-2 were obtained from published U.S. Department of Commerce statistics for 1975 through 1979 and from projected or estimated statistics for 1980.[1-10] The uncontrolled emission factors given in Table 5-2 are the upper limit of the range of the emission factors given in Table 5-1 or are published emission factors.[11,12] Consequently, the emissions given in Table 5-2 are thought to represent maximum estimated emissions for each industry. The largest source of particulate matter emissions is the soybean oil mill segment, which emits an estimated 17,010 Mg/yr (18,750 tons/yr). The

TABLE 5-1. SUMMARY OF EMISSION FACTORS DEVELOPED FROM TEST AND PERMIT DATA

Industry	Typical process weight rate		Controlled emission factor[a]		Uncontrolled emission factor[a]	
	Mg/h	tons/h	kg/Mg	lb/ton	kg/Mg	lb/ton
Soybean mills[b] (SIC 2075)	13.6	15	0.04-0.27	0.1-0.6	0.13-0.7	0.3-1.5
Wet corn milling[c] (SIC 2046)	8.2	9	0.15-0.32	0.3-0.7	0.09-0.7	0.2-1.0
Pet food[d] (SIC 2047)	7.2	8	0.125	0.25	0.7	1.6
Beet sugar[c] (SIC 2063)	9.1	10	0.13-0.7	0.3-1.5	0.7-2.7	1.5-6.0
Alfalfa dehydrators[c] (SIC 2048)	5.4	6	0.45-1.4	1.0-3.0	0.75-5.0	1.5-10.0
Malt beverages[c] (SIC 2082)	3.6	4.0	0.9	2.0	N/A	N/A
Animal and Marine Fats[e]	3.6	4.0	N/A	N/A	0.3	0.6

N/A = Not available.
[a]Expressed in terms of Mg and tons of dried product.
[b]Estimated from permit and test data.
[c]Calculated from available emission test data.
[d]Estimated from equipment manufacturer's test data.
[e]Estimate from test data for feather meal drying.

TABLE 5-2. SUMMARY OF NATIONAL PARTICULATE MATTER EMISSIONS BY INDUSTRY

Industry	Annual production[a] ($\times 10^3$)		Uncontrolled emission factor[b]		Current national emissions	
	Mg/yr	tons/yr	kg/Mg	lb/ton	Mg/yr	tons/yr
Soybean oil mills	22,680	25,000	0.7	1.5[c]	17,010	18,750
Wet corn milling	3,084	3,400	0.5	1.0[d]	1,542	1,709
Alfalfa dehydrators	1,089	1,200	5.0	10.0[d]	5,433	6,012
Beet sugar	1,270	1,400	3.0	6.0[d]	3,810	4,200
Dog, cat, and other pet food	2,359	2,600	0.7	1.6[e]	1,887	2,080
Animal and marine fats	508	560	0.3	0.6[d]	152	168
Distilled liquor	444	490	2.3	5.0[f]	1,111	1,225
Malt beverages	363	400	2.3	5.0[g]	907	1,000

[a] Annual production estimated from References 1-10.
[b] Expressed in terms of Mg and tons of dried product.
[c] Factor given in Reference 11.
[d] Calculated from available emission test data.
[e] Estimated from equipment manufacturer's test data.
[f] Assumed to be the same as for spent grain dryers in the malt beverages industry due to similarity of processes.
[g] Factor given in Reference 12.

smallest source of particulate matter is the animal and marine oils and fats segment, which emits an estimated 152 Mg/yr (168 tons/yr).

There is potential for sulfur dioxide emissions when direct-fired dryers are used with oil, coal, or lignite as fuel. However, natural gas is presently the fuel most frequently used. There are little or no data available upon which to base estimates of sulfur dioxide emissions from this source category.

5.3 REFERENCES

1. 1977 Census of Manufacturers: Fats and Oils. U.S. Department of Commerce. Washington, D.C. July 1980.

2. Current Industrial Reports: Fats and Oils--Oilseed Crushings. U.S. Department of Commerce. Washington, D.C. June 1981.

3. 1977 Census of Manufacturers: Grain Mill Products. U.S. Department of Commerce. Washington, D.C. August 1980.

4. Current Industrial Reports: Grain Mill Products. U.S. Department of Commerce. Washington, D.C. June 1980.

5. 1977 Census of Manufacturers: Sugar and Confectionary Products. U.S. Department of Commerce. Washington, D.C. July 1980.

6. 1977 Census of Manufacturers: Animal and Marine Fats and Oils. U.S. Department of Commerce. Washington, D.C. July 1980.

7. Current Fishery Statistics No. 8100. Fisheries of the United States, 1980. U.S. Department of Commerce. Washington, D.C. April 1981.

8. Current Industrial Reports: Beverages. U.S. Department of Commerce. Washington, D.C. 1979.

9. 1977 Census of Manufacturers: Beverages. U.S. Department of Commerce. Washington, D.C. July 1980.

10. Distilled Spirits Council of the United States Annual Statistical Review 1980. Washington, D.C. September 1981.

11. Compilation of Air Pollutant Emission Factors. AP-42. U.S. Environmental Protection Agency. Office of Air Quality Planning and Standards. Research Triangle Park, N.C. 1973. Section 6.4 revised April 1977.

12. Reference 11. Section 6.5.1 revised February 1980.

6. EMISSION CONTROL SYSTEMS

6.1 CONTROL APPROACHES

Particulate matter control devices used at plants in the source category include: cyclones used singly, in series, and in parallel; venturi scrubbers; orifice-type scrubbers; mechanical centrifugal collectors with water spray; and wet mechanical scrubbers. Packed bed scrubbers and incinerators are used for odor control on the emissions from the drying of feather meal and fish meal.

Recently, several dryer manufacturers have begun to include partial exhaust gas recirculation as a part of the dryer system. Recirculation of the hot gases reduces the energy requirements of the dryer and is claimed to reduce emissions.

6.1.1 Product Recovery for the Animal Feed Dryer

Efficient product recovery is essential to profitable plant operations, and product recovery devices are usually purchased as part of a drying system. These devices separate the exhaust gases from the entrained product. Large discharge housings at the end of the dryer drum and cyclones are among the devices used for product recovery. Discharge housings or settling chambers allow the product to drop out of the exhaust gas stream, and cyclones separate particulate matter from the effluent gas by changing the direction and velocity of the stream.

6.1.2 Emission Control for the Animal Feed Dryer

Table 6-1 lists types of control devices used in the industries which make up the animal feed source category. This table was compiled using information obtained in plant visits and from emission test reports, industry contacts, and manufacturers' literature.

6.1.2.1 Dry Collectors. A cyclone with a high inlet velocity, small diameter, and long cone is commonly called a high-efficiency

TABLE 6-1. CONTROL DEVICES USED ON EMISSIONS FROM ANIMAL FEED DRYERS BY SIC CODE

SIC Code	Industry type	Control device
2046	Wet corn milling	High efficiency cyclones Multiclones, Venturi scrubbers
2047	Dog, cat and other pet foods	Multiclone
2048	Prepared feeds, NEC	Wet scrubbers, Partial recycle of exhaust air
2063	Beet sugar	Cyclones, Partial recycle of exhaust air
2075	Soybean oil mills	High efficiency cyclones
2077	Animal and marine fats fats and oils	Incinerators, Packed bed scrubbers
2082	Malt beverage	Mechanical, centrifugal collectors with water spray
2085	Distilled liquor	Mechanical, centrifugal collectors with water spray

cyclone. One type of high-efficiency cyclone consists of a cylinder with a tangential gas inlet, an axial gas outlet, and a conical lower section with an axial dust outlet. The tangential, high-velocity gas entry imparts a circular motion to the gas stream; the particles, because of their greater inertia, tend to concentrate on the wall of the cyclone. The gas follows a double vortex path, spiraling down at the outside and up at the inside to the gas outlet. The downward spiral assisted by gravity carries the particles to the dust outlet.

Cyclone efficiency increases with an increase in any of the following: density of the particulate matter, particle diameter, inlet velocity, length of cyclone, ratio of cyclone body diameter to cyclone outlet diameter, and number of gas revolutions within the cyclone.[1]

6.1.2.2 Wet Collectors. A variety of wet collection devices exist for the control of particulate matter emissions. These are described below.

In a mechanical, centrifugal collector with water sprays, a spray of water is added to the inlet to increase collection efficiency. The wet fan serves as a surface for impingement of dust particles. The spray formed by the fan functions mainly to keep the blades wet and flush away the collected dust. This type of collector has limited effectiveness for particulate matter in the submicron range and is subject to dust buildup and corrosion at the blades.[2]

In a venturi scrubber, the exhaust gas passes through a venturi to which water is added at the throat. Venturi scrubbers commonly have gas velocities at the throat that range from 4,570 to 6,100 meters per minute (mpm) (15,000 to 20,000 feet per minute [fpm]).[3] Pressure drops range from 2,488 to 7,565 pascals (Pa) (10 to 30 inches H_2O).[3] Impaction of the particles by liquid drops is the predominate collection mechanism. The high velocity at the throat causes turbulence, which promotes intimate particle/liquid contact. The wetted particles and droplets are collected in a cyclone spray separator. A venturi scrubber can have a high (98+ percent) collection efficiency for particulate matter in the submicronmeter range, if operated at a high pressure drop. These scrubbers are not used commonly by industries in the animal feed source category.

In orifice type scrubbers, the gas stream passes over a reservoir of scrubbing liquid at high velocity just before entering an orifice. The high velocity of the gas entrains the scrubbing liquid droplets, which interact with the particulate matter in and immediately after the orifice. Centrifugal forces, impingement, and turbulence cause wetting of the particles and their collection. Zig-zag or baffle plates remove spray droplets at the gas exit.

In wet mechanical scrubbers, the spray of scrubbing liquid is generated by a mechanical rotor or fan which disperses the scrubbing liquid into droplets. The most efficient wet mechanical systems are designed to produce finely divided liquid droplets and extreme turbulence, which increases chances of collision between dust particles and liquid droplets to increase capture efficiency.[4] Like mechanical centrifugal collectors with water sprays, these scrubbers are subject to particulate matter buildup or corrosion at the rotor blades.

6.1.2.3 Odor Control. Packed bed scrubbers used for odor control also remove particulate matter. Odor removal by wet scrubbing is a function of the residence time of the odor-laden air in the scrubber, the available contact area, and the solubility of the odor-causing pollutant in the scrubbing liquid. Packed bed scrubbers observed in the control of animal feed dryers typically contain three sections. In the first section, water sprays are used to cool the exhaust gases and to entrain and remove some of the odor-causing pollutant. The second chamber contains a packed bed to increase retention time and contact area. Sulfuric acid (5 to 10 percent) is sprayed into this chamber to oxidize the odor-causing particles to nonodorous or easily removable compounds. Next, the gas stream is contacted with chlorine gas to further oxidize the odor-causing pollutant. In the third chamber, caustic is sprayed onto a packed bed to neutralize the scrubbing solution prior to discharge.

Water and chemical flow rates in packed bed scrubbers vary depending on the exhaust gas flow rate. An observed packed bed scrubber controlling a fish meal dryer had a gas flow rate of 17.7 m^3/s (37,500 cfm), a water flow rate of 0.063 m^3/s (1,000 gpm), and sulfuric acid and caustic flow

rates each of 0.02 m^3/s (384 gpm).[4] The collection efficiency for this scrubber is claimed to be 98 percent of all particles larger than 8 μm.[5]

Incinerators and waste heat boilers have been used to control odors from fish and feather meal dryers. The use of the exhaust gas from the product recovery cyclone as combustion air for the burner in the plant boiler is also used as an odor control system in these industries.

6.2 BEST SYSTEMS OF EMISSION REDUCTION

The available data are too limited to determine the most effective systems of emission control for each industry in the source category. However, the available information does indicate that the most effective system of control would include the use of pollution control devices in series with product recovery devices. Energy conservation programs have led some industries to employ exhaust gas recirculation with claims of both energy savings and emissions reduction.

6.3 REFERENCES

1. Air Pollution Engineering Manual (Second Edition). U.S. Environmental Protection Agency. Research Triangle Park, N.C. AP-40. May 1973. p. 93.

2. U.S. Environmental Protection Agency. Office of Air Quality Planning and Standards. Control Techniques for Particulate Emissions from Stationary Sources. Volume 1. Preliminary Draft. Research Triangle Park, N.C. July 1980. p. 4.5-12.

3. Reference 1, p. 104.

4. Reference 2. p. 4.5-15 to 16.

5. Memo from Gold, B. D., MRI/N.C., to Telander, J. A., EPA/ISB. August 14, 1981. Plant Visit--Standard Products Plant, Southport, N.C.

7. EMISSION DATA

7.1 AVAILABILITY OF DATA

Emission test data were obtained from State and local control agencies, plants, and equipment vendors. Particulate matter sampling was typically conducted using EPA Reference Method 5 (with modification as required by the situation). In one case, a high-volume sampling train was used. Odor sampling was conducted at one plant using ASTM Method D 1391-57.

Table 7-1 includes (1) results of particulate matter emission testing and (2) calculated allowable emissions using the appropriate State regulation (typically in the form of a process weight rate equation). The emissions presented in the table are characterized as controlled or uncontrolled depending on whether or not the device associated with the dryer was used primarily for product recovery. In only a few cases were test data obtained for controlled emissions.

Insufficient data were available on dryer operating conditions and characteristics of the feed material to determine the effect, if any, of these factors on particulate matter emissions.

7.2 SAMPLE COLLECTION AND ANALYSIS

EPA Reference Method 5 is the recommended method for measuring particulate matter emissions in this source category. Depending upon the moisture content of the exhaust gas, modification of the method may be required.

7.3 REFERENCES

1. Source Sampling Reports for Plants A-L provided by plants and State and local air pollution control agencies.

TABLE 7-1. EMISSION TEST DATA[a]

Industry/Plant	Date of test	No. of tests	Dryer type	Control type	Dryer process weight rate Mg/h (tons/h)	Stack gas flow rate rate m^3/s (acfm)	Uncontrolled emission rate g/m^3 (gr/dscf)	Uncontrolled emission rate kg/h (lb/h)	Controlled emission rate g/m^3 (gr/dscf)	Controlled emission rate kg/h (lb/h)	Allowable emissions kg/h (lb/h)
Wet corn milling (SIC 2046)											
Plant A	1976	3	Direct-fired rotary	Cyclone[b]	9.4 (10.4)	8.44 (17,880)	0.055 (0.024)	1.25 (2.76)	--	--	8.99 (19.7)[d]
Plant B[c]	1979	3	4 Direct-fired rotary	Scrubber-venturi	N/A	82.54 (174,900)	--	--	0.163 (0.0713)	27.2 (60)	72.6[d] (160)[d]
	1979	3	4 Direct-fired rotary	Scrubber-venturi	N/A	94.24 (199,700)	--	--	0.185 (0.0809)	37.2 (82)	72.6[d] (160)[d]
	1980	3	4 Direct-fired rotary	Scrubber-venturi	N/A	75.27 (159,500)	--	--	0.195 (0.085)	33.1 (73)	472.6[d] (160)[d]
	1980	3	3 Direct-fired rotary)	Scrubber-venturi	N/A	75.36 (159,700)	--	--	0.146 (0.064)	24.9 (55)	54.4 (120)[e]
Plant C[c]	1977	3	Rotary steam tube (No. 7)	--	40 (4.36)	3.12 (6,621)	0.140 (0.061)	0.60 (1.33)	--	--	5.0 (11.0)
	1977	3	Rotary steam tube (No. 8)	--	4.11 (4.53)	3.08 (6,517)	0.167 (0.167)	0.72 (1.59)	--	--	5.2 (11.4)
	1977	3	Rotary steam tube (No. 9)	--	4.16 (4.59)	3.36 (7,119)	0.144 (0.063)	0.66 (1.33)	--	--	52.2 (11.4)
	1981	3	Rotary steam tube (No. 5)	--	6.15 (6.78)	2.73 (5,785)	0.220 (0.096)	0.69 (1.53)	--	--	6.7 (14.8)
	1977	9	Rotary steam tube	Mill cyclone,[b]	4.11 (4.53)	5.68 (12,032)	0.014 (0.006)	0.69 (0.53)	--	--	5.1 (11.3)
	1981	3	Rotary steam tube	Mill cyclone,[b]	4.22 (4.66)	5.39 (11,431)	0.003 (0.013)	0.50 (1.10)	--	--	5.2 (11.5)
	1977	9	Rotary steam tube (+ Hammermill)	Product cyclone,[b]	4.04 (4.45)	5.40 (11,437)	0.055 (0.024)	0.97 (2.14)	--	--	5.0 (11.1)
	1981	3	Rotary steam tube (+ Hammermill)	Product cylone,	4.28 (4.72)	4.79 (10,154)	0.096 (0.042)	1.50 (3.30)	--	--	5.3 (11.6)
	1980	3	Rotary steam tube	--	1.02 (1.12)	2.06 (4,366)	0.215 (0.094)	0.74 (1.63)	--	--	2.0 (4.4)
Alfalfa dehydrators (SIC 2048-9)											
Plant D	1976	2	Direct-fired rotary + hammermill	Cyclones[b]	3.10 (3.42)	10.24 (21,690)	0.616 (0.269)	20.55 (45.3)	--	--	5.8 (12.7)
Plant E	1974-1976	57	Direct-fired rotary	Multiple configurations	--	--	--	2.1-13.7 (4.6-30.2)	--	--	5.0-15.0 (11.0-33.1)

(continued)

TABLE 7-1. (continued)

Industry/Plant	Date of test	No. of tests	Dryer type	Control type	Dryer process weight rate Mg/h (tons/h)	Stack gas flow rate rate m^3/s (acfm)	Uncontrolled emission rate g/m^3 (gr/dscf)	Uncontrolled emission rate kg/h (lb/h)	Controlled emission rate g/m^3 (gr/dscf)	Controlled emission rate kg/h (lb/h)	Allowable emissions kg/h (lb/h)
Beet sugar (SIC 2063)											
Plant F	1977	5	Rotary kiln (lignite-fired)	Cyclone, skimmer[b]	200 (211)	6.47 (13,700) (dscfm)	0.149 (0.065)	3.45 (7.6)	--	--	19.5 (43.0)
Plant G	1980	3	Direct-fired rotary drum	--	65.5 (72.2)	13.07 (27,700)	0.311 (0.136)	7.53 (16.6)	--	--	13.9 (30.4)
	1980	3		--	41.9 (46.2)	13.35 (28,300)	0.389 (0.170)	9.03 (19.9)	--	--	11.1 (24.4)
Plant H	1980	3	Direct-fired rotary drum	--	30.4 (33.5)	14.06 (29,800)	0.254 (0.111)	6.1 (13.5)	--	--	13.7 (30.3)
	1980	3		--	20.3 (22.4)	15.86 (33,600)	0.215 (0.094)	6.8 (15.1)	--	--	11.2 (24.6)
Plant I	1980	3	Direct-fired rotary drum	--	43.9 (48.4)	12.88 (27,300)	0.366 (0.160)	7.7 (17.0)	--	--	14.6 (32.1)
	1980	3		--	43.9 (48.4)	9.25 (19,600)	0.378 (0.165)	5.7 (12.5)	--	--	14.6 (32.2)
Plant J	1977	4	Indirect-fired rotary	Cyclone	22.7 (25)	N/A	--	--	0.183 (0.08)	11.8 (26.1)	16.1 (35.4)
Animal and marine fats and oils (SIC 2077)											
Plant K	1978	N/A	1 Ring; 1 Rotary steam tube	2 cyclones in parallel[b]	3.7 (4.1)	N/A	0.641 (0.28)	1.1 (2.5)	--	--	3.9 (8.5)
Malt beverages (SIC 2082)											
Plant L	1978	3	2 direct-fired rotary drums	2 wet fan collectors	3.8 (4.2)	6.8 (13,300)	--	--	0.112 (0.049)	1.23[f] (2.72)	4.9 (10.8)

N/A = Data not available.
[a] Source sampling reports provided by the plants and by State and local air pollution control agencies.[1]
[b] Based on process description or manufacturing practice, this control equipment is used primarily for product recovery.
[c] Emission rate calculated using front-half and back-half catch, as per Iowa regulation.
[d] Allowable emissions for the 4 dryers.
[e] Allowable emissions for the 3 dryers.
[f] Each dryer.

8. STATE AND LOCAL EMISSIONS REGULATIONS

This chapter provides information on State and local regulations that are applicable to animal feed dryers. These data were compiled from telephone contacts with State and local pollution control agencies and from the Environment Reporter.[1,2]

8.1 SUMMARY OF EMISSION REGULATIONS

Animal feed drying plants operate in 47 States. All 47 States regulate particulate matter emissions from new and existing plants. The State regulations for new plants (see Table 8-1 following page 8-2) are more stringent than those for existing plants. All but four States have opacity limitations (Table 8-1). Most of the States limit opacity to 20 percent with exceptions that permit higher levels for a small percentage of time in an hour or a day. In addition, most States have odor restrictions on animal feed dryers restricting odors to no more than 150 odor concentration units as determined by an odor panel.

Thirty-four of the forty-seven States use the process weight rate equations shown below to determine allowable particulate matter emissions from animal feed dryers.

Equation Set 1:	$E = 3.59\ P^{0.62}$	$P \leq 30$ tons/h
	$E = 17.31\ P^{0.16}$	$P > 30$ tons/h
Equation Set 2:	$E = 4.10\ P^{0.67}$	$P \leq 30$ tons/h
	$E = 55\ P^{0.11} - 40$	$P > 30$ tons/h

where E equals allowable particulate matter emission rate in pounds per hour and P equals process weight rate in tons per hour. Twenty-two States use Equation Set 2, ten States use Equation Set 1, and two States use both equations for different conditions. Using Equation Set 1 and assuming process weight rates of 18 and 36 Mg/h (20 and 40 tons/h),

allowable emissions would be 10.4 kg/h (23.0 lb/h) and 14.2 kg/h (31.2 lb/h), respectively. Using Equation Set 2 and the same process weight rate assumptions, allowable emissions would be 13.8 kg/h and 19.3 kg/h (30.5 lb/h and 42.5 lb/h), respectively.

New Jersey, Pennsylvania, and the South Coast Air Quality Management District have the lowest particulate matter emission limits. A dryer processing 4.5 Mg/h (5 tons/h) would be restricted to 3.9 kg/h (8.5 lb/h) of particulate matter emissions in these three areas but would be allowed to emit 5.4 kg/h (12 lb/h) of particulate matter (based on Equation Set 2) in most of the remaining States.

Three States--Arkansas, Illinois, and Indiana--have particulate matter emission limits specific to animal feed drying plants. Arkansas has a specific regulation for poultry feed mills and soybean oil mills (Table 8-1). Illinois has a special regulation for wet corn mills, and Indiana sets particulate matter emission limits on a case-by-case basis for soybean oil mills and wet corn mills. New Mexico and Utah set particulate matter emission limits for all plants on a case-by-case basis.

8.2 REFERENCES

1. Telecon: Shular, J., MRI, with McGrogan, Jr. Pennsylvania Bureau of Air Quality Control. July 7, 1981. Information on particulate matter and opacity standards.

2. Environment Reporter. State Air Laws. Volumes 1, 2, and 3. Bureau of National Affairs. Washington, D.C. pp. 301:0101 to 556:0501.

TABLE 8-1. SUMMARY OF STATE AIR POLLUTION REGULATIONS

State	Particulate	Opacity	Air pollution regulation reference
Alabama	Equation Set 1[a]	20%[b]	Alabama Air Pollution Control Commission Rules and Regulations, Chapters 1 through 6. March 1981.
Arizona	Equation Set 2[c] except Phoenix-Tuscon region use Equation Set 1	40%	Arizona Code Title 9--Health Services Chapter 3--Air Pollution Control. February 1980.
Arkansas	Special[d]	No. 1 Ringleman	Arkansas Regulations of Plan of Implementation For Air Pollution Control. June 1975.
California			
Bay Area	Equation Set 2	20%[b]	Bay Area Air Quality Management District Region IV. September 1977.
South Coast	Process weight rate Table 405(a)	20%[b]	Rules and Regulations South Coast Air Quality Management District Region IV. September 1977.
Colorado	Equation Set 1	20%	Code of Colorado Regulations, Volume 5, Air Pollution Regulations 1, 2, and 3. December 1978.
Connecticut	Equation Set 1	20%[b]	Regulations of Connecticut State Agencies Abatement of Air Pollution. October 1980.
Florida	Equation Set 1	20%	Rules of the Florida Department of Environmental Regulation Chapter 17-2. Air Pollution. June 1979.
Georgia	Equation Set 2	40%	Rules and Regulations. State of Georgia. Chapter 391-3-1. Air Quality Control. November 1980.

(continued)

TABLE 8-1. (continued)

State	Particulate	Opacity	Air pollution regulation reference
Hawaii	Equation Set 2	20%[b]	Hawaii Environmental Laws and Regulations. Volume II, Public Health Regulations, Chapter 43. May 1976.
Idaho	Equation Set 2	20%	Rules and Regulations for the Control of Air Pollution in Idaho, Department of Health and Welfare. September 1980.
Illinois	Equation Set 3[e] except wet corn Equation Set 2	30%[b]	Illinois Stationary Source Standards, Rules 201, 202, 203. September 1979.
Indiana	Equation Set 2 except certain soybean mills and wet corn mills	40%, attainment area, 30%, non-attainment area, exceptions	Indiana Administrative Code Title 325--Air Pollution Control Branch. March 1981.
Iowa	Equation Set 2	None	Iowa Department Rules 1973. Environmental Quality Department, Title 1. March 1979.
Kansas	Equation Set 2	20%	Kansas Air Pollution Emission Control Regulations. January 1974.
Kentucky	Equation Set 1	20%	Kentucky Air Pollution Control Regulations, Title 401, Chapters 50 through 65. June 1979.
Louisiana	Equation Set 2	20%[b]	Rules of Louisiana Department of Natural Resources. December 1980.
Maine	Equation Set 1	20%	Department of Environmental Protection. Bureau of Air Quality Control, Chapters 100-109, 111-114, and 130. January 1980.

(continued)

TABLE 8-1. (continued)

State	Particulate	Opacity	Air pollution regulation reference
Hawaii	Equation Set 2	20%[b]	Hawaii Environmental Laws and Regulations. Volume II, Public Health Regulations, Chapter 43. May 1976.
Idaho	Equation Set 2	20%	Rules and Regulations for the Control of Air Pollution in Idaho, Department of Health and Welfare. September 1980.
Illinois	Equation Set 3[e] except wet corn Equation Set 2	30%[b]	Illinois Stationary Source Standards, Rules 201, 202, 203. September 1979.
Indiana	Equation Set 2 except certain soybean mills and wet corn mills	40%, attainment area, 30%, non-attainment area, exceptions	Indiana Administrative Code Title 325--Air Pollution Control Branch. March 1981.
Iowa	Equation Set 2	None	Iowa Department Rules 1973. Environmental Quality Department, Title 1. March 1979.
Kansas	Equation Set 2	20%	Kansas Air Pollution Emission Control Regulations. January 1974.
Kentucky	Equation Set 1	20%	Kentucky Air Pollution Control Regulations, Title 401, Chapters 50 through 65. June 1979.
Louisiana	Equation Set 2	20%[b]	Rules of Louisiana Department of Natural Resources. December 1980.
Maine	Equation Set 1	20%	Department of Environmental Protection. Bureau of Air Quality Control, Chapters 100-109, 111-114, and 130. January 1980.

(continued)

TABLE 8-1. (continued)

State	Particulate	Opacity	Air pollution regulation reference
Maryland	1.15 x10-4 kg/dscm (0.05 gr/dscf)	20%[b]	Code of Maryland Regulations, Title 10--Health and Mental Hygiene, Subtitle 18--Air Quality. May 1980.
Massachusetts	Process weight rate table (to 30 tons/h) Equation Set 4[f] (over 30 tons/h prod.)	No. 1 Ringleman[b]	Code of Massachusetts Regulations Title 310 Environmental Quality Regulation 7--Air Pollution Control. October 1980.
Michigan	Equation Set 2	20%[b]	Michigan Administrative Code, Air Pollution Control Commission General Rules, Part 1 through 7, 9 through 11, 13, 16 and 17. July 1980.
Minnesota	Equation Set 1	20%	Minnesota Code of Agency Rules, Title 6, Environment Part 4. APCR and A.Q.S.APC 1 through 19 and 21 through 32. December 1979.
Mississippi	Process weight rate table e.g., 8 tons/h, 16.50 lb/h	40%	Mississippi Air and Water Pollution Control Commission, Air Quality Regulations 5-1, 5-2, and 5-3. January 1979.
Missouri	Equation Set 2	No. 1 Ringleman[b]	Missouri Code of State Regulations, Title 10--Department of Natural Resources, Division 10--Air Conservation Commission, Chapters 1 through 5. April 1980.
Montana	Equation Set 2	20%	Montana Administrative Code, Title 16, Chapter 8, Environmental Sciences Division, Subchapters 7 and 9 through 14. August 1980.

(continued)

TABLE 8-1. (continued)

State	Particulate	Opacity	Air pollution regulation reference
Nebraska	Equation Set 2	20%	Nebraska Department of Environmental Control Air Pollution Control Rules and Regulations. August 1980.
Nevada	Process weight chart[g]	20%	Department of Conservation and Natural Resources, Division of Environmental Protection--Air Quality Regulations. April 1980.
New Hampshire	Equation Set 2	20%	New Hampshire Process, Manufacturing, Service Miscellaneous Industries Regulation. April 1979.
New Jersey	99% collection efficiency[h]	20%[b]	New Jersey Administrative Code, Chapter 27 and Subchapter 6. May 1977.
New Mexico	No general manufacturing standard		Environmental Improvement Board Ambient Air Quality Control Regulations. Sections 100 through 1301. March 1979.
New York	Equation Set 5[i]	20%	Codes, Rules and Regulations of the State of New York, Title 6, Chapter III, Air Resources, Subchapter A, Prevention and Control of Air Contamination and Air Pollution, Parts 212 through 222. January 1981.
North Carolina	Equation Set 2	20%[b]	North Carolina Air Pollution Control Regulations. July 1980.
North Dakota	Equation Set 2	20%[b]	North Dakota Administrative Code, Title 33, Article 33-15, Air Pollution Control. July 1978.

(continued)

TABLE 8-1. (continued)

State	Particulate	Opacity	Air pollution regulation reference
Ohio	Equation Set 2	None	Ohio Particulate Matter Standards. March 1981.
Oklahoma	Equation Set 2	20%	Air Quality Council Regulations 1 through 19. April 1980.
Oregon	Equation Set 2	20%	Oregon Administrative Rules, Chapter 340, Department of Environmental Quality: Air Pollution Control. August 1979.
Pennsylvania	0.02 gr/dscf or Equation Set 6[j]	20%[b]	Pennsylvania Code Title 25 Part 1. Department of Environmental Resources, Chapters 121 through 141. February 1981.
Rhode Island	Equation Set 2	20%	Rhode Island Department of Health Division of Air Pollution Control Regulations. February 1980.
South Carolina	Equation Set 2	None	South Carolina Department of Health and Environmental Control Regulation 61-62. November 1980.
South Dakota	Equation Set 2	No. 1 Ringleman[b]	Administrative Rules of South Dakota, Chapter 34:10. November 1975.
Tennessee	Equation Set 1	20%	Tennessee Department of Public Health, Division of Air Pollution Control, Chapters 1200-3-1 through 1200-3-20. December 1979.
Texas	Equation Set 7[k]	20%	Texas Administrative Code, Title 31--Natural Resources, Chapter 111--Particulates. April 1981.

(continued)

TABLE 8-1. (continued)

State	Particulate	Opacity	Air pollution regulation reference
Utah	Footnote m	20%[b]	Air Conservation Regulations of Utah State Division of Health Conservation Committee. April 1981.
Vermont	Process weight chart[n]	20%[b]	Agency of Environmental Conservation, Environmental Protection Regulations. Chapter 5-Air Pollution Control. November 1979.
Virginia	Equation Set 2	20%[b]	State Air Pollution Control Board Regulations for the Control and Abatement of Air Pollution, Parts I-VIII. June 1981.
Washington	0.10 gr/dscf	20%[b]	Washington Administrative Code. Title 173--Department of Ecology, Chapters 173-400 through 173-490. March 1980.
Wisconsin	Equation Set 1	20%[b]	Wisconsin Administrative Code, Chapter NR154--Air Pollution Control. February 1980.
Wyoming	Equation Set 1	20%[b]	Rules and Regulations of Department of Environmental Quality, Air Quality Division, Chapter 1. January 1979.

[a]Equation Set 1:

$E = 3.59P^{0.62}$ $P \leq 30$ tons/h

$E = 17.31P^{0.16}$ $P > 30$ tons/h

[b]Exceptions from opacity standards are allowed. These vary from State to State; some allow 30% or 40% or even 60% for one 6-minute period in any 1-hour period.

[c]Equation Set 2:

$E = 4.1P^{0.67}$ $P \leq 30$ tons/h

$E = 55.0P^{0.11-40}$ $P > 30$ tons/h

TABLE 8-1. (continued)

[d] For poultry feed mill, 32 lb/h. For soybean mills, 1.5 lb/ton of grain processed. Other processes process weight rate curve, e.g., 5 tons/h, 95 lb/h.

[e] Equation Set 3:

$E = 2.54P^{0.534}$ $P \leq 450$ tons/h

$E = 24.8P^{0.16}$ $P > 450$ tons/h

[f] Equation Set 4:

$E = 1/2\ (55P^{0.11}-40)$ $P > 30$ tons/h

[g] Example of process weight chart:

Process weight rate (kg/h)	2,000	4,000	8,000	10,000	20,000	100,000
Allowable emissions (kg/h)	3.14	5.0	7.95	9.23	14.79	23.65

[h]

Potential emission rate from source operation, lb/h	Allowable emission rate, lb/h (based on 99% efficiency of collection)	Source gas emitted from source scf/min	Allowable emission rate lb/h (based on 0.02 gr/scf)
50 or less	00.5	3,000 or less	0.5
100	01.0	6,000	1.0
1,000	10.0	35,000	6.0
2,000	20.0	70,000	12.0
3,000 or greater	30.0	140,000	24.0
		175,000 or greater	30.0

[i] Equation Set 5:

$E = 0.024P^{0.67}$ $P \leq 50$ tons/h

$E = 0.030$ gr/dscf of undiluted exhaust gas $P > 50$ tons/h

[j] Equation Set 6:

$A = 0.76E^{0.42}$

A = Allowable emissions in lb/h

E = Emission index = FxW lb/h

F = Process factor in lb/unit

W = Production or charging rate in units/h

TABLE 8-1. (continued)

[k]Equation Set 7:

$E = 3.12P^{0.985}$ $P \leq 20$ tons/h

$E = 25.4P^{0.287}$ $P > 20$ tons/h

[m]Emission limits set on a facility basis based on permit data and confirmed by a compliance test.

[n]Example of process weight chart.

Process weight lb/h	Emissions lb/h
4,000	5.93
6,000	7.37
8,000	8.71
10,000	10.0
12,000	11.28
16,000	13.74

APPENDIX A

LISTS OF COMPANIES FOR SIC CODES DESCRIBED IN CHAPTER 4

TABLE A-1. SOYBEAN OIL (SIC 2075)[a]

Company	Company location
Allied Mills, Inc.	Chicago, Ill.
American Lecithin Company, Inc.	Atlanta, Ga.
Anderson, Clayton & Company	Houston, Tex.
Archer-Daniels-Midland Company	Decatur, Ill.
Boone Valley Cooperative Processing Assn.	Eagle Grove, Iowa
Central Soya Company, Inc.	Ft. Wayne, Ind.
Hartsville Oil Mill	Hartsville, S.C.
Lauhoff Grain Company	Danville, Ill.
PVO International Inc.	San Francisco, Calif.
Planters Mfg. Company	Clarksdale, Miss.
Planters Oil Mill, Inc.	Rocky Mount, N.C.
Producers Cooperative, Inc.	Richmond, Va.
Ralston Purina Company	St. Louis, Mo.
Riceland Foods, Inc.	Stuttgart, Ark.
J. R. Short Milling Company	Chicago, Ill.
Spencer Kellogg	Buffalo, N.Y.
A. E. Staley Mfg. Company	Decatur, Ill.

[a]Source: Standard and Poor's Register of Corporations, Directors and Executives. Volume 3. 1981.

TABLE A-2. WET CORN MILLING (SIC 2046) PLANTS

Plant Name	Plant location	Telephone No.	Vegetable milled
ADM Corn Sweeteners	1350 Waconia Avenue, S.W., Cedar Rapids, Iowa 52406	(319) 398-0600	Corn
ADM Corn Sweeteners	Post Office Box 1470, Decatur, Ill. 62525	(217) 424-5752	Corn
Alembic (1983)	Becker, Minn.	--	Corn
American Maize Products Co.	Rt. 1, Alabama State Dock Road, Decatur, Ala. 35601	(205) 355-8815	Corn
American Maize Products Co.	113th and Indianapolis Blvd., Hammond, Ind. 46326	(219) 659-2000	Corn
Amstar Corp.	E. Jones & 7th Sts., P. O. Box 169, Dimmitt, Tex. 79027	(806) 647-4141	Corn
Anheuser Busch, Inc.	2245 Sagamore Parkway, Lafayette, Ind. 47902	(317) 447-6911	Corn
Cargill, Inc.	1710 16th St. S.E., P. O. Box 1467, Cedar Rapids, Iowa 52406	(319) 366-3591	Corn
Cargill, Inc.,	3201 Needmore Road, Dayton, Ohio 45414	(513) 236-1971	Corn
Cargill, Inc.	4943 Stepherson Road, Memphis, Tenn. 38113	(901) 795-2660	Corn
Chemstar Products	McPherson, Kans.		Corn
Clinton Corn Processing Co.	1251 Beaver Channel Parkway, Clinton, Iowa 52732	(319) 242-1121	Corn
Clinton Corn Processing Co.	Montezuma, N.Y. 13117	(315) 776-4811	Corn
Colorcon	Indianapolis, Ind.	--	Corn
CPC International, Inc.	64 and Archer Road, Argo, Ill. 60501	(312) 458-2000	Corn
CPC International, Inc.	1300 S. 2nd Street, P. O. Box 31, Pekin, Ill. 61554	(309) 346-1121	Corn
CPC International, Inc.	1001 Bedford, N. Kansas City, Mo. 64116	(816) 471-8000	Corn
CPC International, Inc. (1981)	Stockton, Calif.	--	Corn
CPC International, Inc. (1982)	Winston-Salem, N.C.	--	Corn
Grain Processing Corp./ Kent Feeds, Inc.	1600 Oregon, Muscatine, Iowa 52761	(319) 263-1321	Corn
Great Western Sugar	Johnson, Colo.	--	Corn
Great Western Sugar (1983)	Reserve, La.	--	Corn
Holly Sugar Corp.	Tracy, Calif.	--	Corn
Hubinger Company/H. J. Heinz	1005 South 5th Street, Keokuk, Iowa 52632	(319) 524-4641	Corn
Lincoln Grain Co./ General Life Co., Inc.	RR 3, P. O. Box 436, Atchison, Kans. 66002	(913) 367-1621	Corn
National Starch and Chemical Corp.	1515 Drover St., P. O. Box 1084, Indianapolis, Ind. 46221	(317) 635-4455	Corn
A. E. Staley Mfg. Co.	2200 Eldorado, Decatur, Ill. 62525	(217) 423-4411	Corn
A. E. Staley Mfg. Co.	Lafayette, Ind. 47903	(317) 474-5474	Corn
A. E. Staley Mfg. Co.	Morrisville, Pa. 19067	(215) 698-9402	Corn
A. E. Staley Mfg. Co.	Loudon, Tenn.	--	Corn
Centennial Mills	1464 N.W. Front Avenue, Portland, Oreg. 97208	--	Wheat
Centennial Mills	Spokane, Wash. 99220	--	Wheat
Henkel	410 Johnson Street, Keokuk, Iowa 52632	(319) 524-2323	Wheat
Industrial Grain Products/ Olgilvie Mills	Aiken, S.C.	--	Wheat
Midwest Solvents Co., Inc.	1300 Main Street, Atchison, Kans. 66002	(913) 367-1480	Wheat
Boise Cascade	Stanfield, Oreg.	--	Potato
Colby Cooperative Starch Co.	Water Street, Caribou, Maine 04736	(207) 492-5971	Potato
Frenchville Starch	Frenchville, Maine 04745	--	Potato
National Starch and Chemical Corp./Stein Hall & Co.	Burleigh Street, Island Falls, Maine 04747		Potato
J. R. Simplot	Heyburn, Idaho 83336	--	Potato
A. E. Staley Mfg. Co., Inc.	Post Office Box 786, Houlton, Maine 04730	(207) 532-9523	Potato
A. E. Staley Mfg. Co., Inc.	North Washington, Box 911, Monte Vista, Colo. 81144	(303) 852-2412	Potato
Western Starch/Western Polymer	P. O. Box 488, Tulelake, Calif. 96134	(916) 667-2269	Potato

TABLE A-3. DOG, CAT, AND OTHER PET FOOD (SIC 2047) PLANTS

Company	Address	Telephone No.	Plant location(s)	U.S. domestic sales volume
		(a) Pet Food Manufacturers		
A.D.M. Pet Food Co.	P.O. Box 81308 Lincoln, Nebr. 68501	(402) 477-4161	· Lincoln, Nebr.	$500,000-$1,000,000 2-5 million lb
A&R Pet Food Co., Inc.	91 Holt St. Buffalo, N.Y. 14206	(716) 854-8060	· Buffalo, N.Y.	N/A
Acme Feed Mills, Inc.	P.O. Box 729 Burlington, N.C. 27215	(919) 226-5552	· Burlington, N.C.	$4-6 million 18,000-20,000 tons
Agway, Inc. (Country Foods Div.)	P.O. Box 4933 Syracuse, N.Y. 13221	(315) 477-7061	· Waverly, N.Y. · St. Mary's, Ohio	N/A
Alabama Feed Mills, Inc.	P.O. Box 2026 Tuscaloosa, Ala. 35403	(205) 752-2588	· Tuscaloosa, Ala.	N/A
Allen Products Co., Inc.	P.O. Box 2187 Allentown, Pa. 18001	(215) 395-3301	· Allentown, Pa. · Crete, Nebr. · St. Paul, Minn.	Above $200 million
Allied Foods, Inc.	P.O. Box 93326 Atlanta, Ga. 30318	(404) 351-2400	· Atlanta, Ga.	N/A
Allied Mills, Inc. (Pet & Specialty Feeds Div.)	10 S. Riverside Plaza Chicago, Ill. 60606	(312) 930-1050	· Everson, Pa. · Peoria, Ill.	N/A
Andersons, The	P.O. Box 119 Maumee, Ohio 43537	(419) 893-5050	· Maumee, Ohio	$5-10 million 15,000-30,000 tons
Attala Company, The	P.O. Box 697 Kosciusko, Miss. 39090	(601) 289-3121	· Kosciusko, Miss.	N/A
Bailes Best-Made Dog Food, Inc.	1515 N. 4th St. Fort Smith, Ark. 72901	(501) 782-4333	· Fort Smith, Ark.	Above $690,000
Benco Pet Foods, Inc.	P.O. Box 270 Zanesville, Ohio 43701	(614) 454-8575	· Zanesville, Ohio	$8-12 million 20-25 million lb
B and M Farms & Milling Co.	55 N. Sillyman St. Cressona, Pa. 17929	(717) 385-1530	· Cressona, Pa.	$4-5 million 30-35 million lb
Bern Extrusion, Inc.	P.O. Box 143 Bern, Kans. 66408	(913) 336-6132	· Bern, Kans.	N/A
Bil-Jac Foods, Inc.	2015 Granger Rd. Medina, Ohio 44256	(216) 239-1121	· Medina, Ohio	N/A
Breeder's Choice Pet Foods, Inc.	16321 E. Arrow Hwy. Irwindale, Calif. 91706	(213) 334-9301	· Irwindale, Calif.	N/A

(continued)

TABLE A-3 (continued)

Company	Address	Telephone No.	Plant location(s)	U.S. domestic sales volume
		(a) Pet Food Manufacturers		
Buckeye Feed Mills, Inc.	P.O. Box 505 Dalton, Ohio 44618	(216) 828-2251	· Dalton, Ohio	$15.-2 million 6.5-7.5 thousand tons
Bush Bros. & Co.	Rt. 4 Dandrige, Tenn. 37725	(615) 623-2361	· Clinton, Tenn.	N/A
C.H.B. Foods, Inc.	P.O. Box 3510 Terminal Island, Calif. 90731	(213) 831-8941	· Terminal Island, Calif. · Los Angeles, Calif. · Long Beach, Calif. · Wilmington, Calif. · San Leandro, Calif. · Kansas City, Kans. · Camp Hill, Pa.	Above $100 million
Cadillac Pet Foods, Inc.	9103 Griffith Morgan Ln. Pennsauken, N.J. 08110	(609) 662-7412	· Pennsauken, N.J.	$18-19 million
Calo Pet Foods, Inc.	P.O. Box 388 Allentown, Pa. 18105	(215) 821-0607	· Allentown, Pa.	1-2 million cases
Carnation Company	5045 Wilshire Blvd. Los Angeles, Calif. 90036	(213) 932-6000	· Oakland, Calif. · Sebring, Ohio · St. Joseph, Mo. · Hillsboro, Ore. · Jefferson, Wisc. · Ft. Dodge, Iowa	Above $250 million Above 750 million lb
Castle & Cooke Foods	P.O. Box 3928 San Francisco, Calif. 94111	(415) 986-3000	· San Diego, Calif. · Honolulu, Hi.	N/A
Central Soya Co., Inc.	1300 Ft. Wayne Natl. Bank Bldg. Ft. Wayne, Ind. 46802	(219) 425-5100	· Decatur, Ind. · Kansas City, Mo.	N/A
Central Valley Products, Inc.	P.O. Box 2437 Turlock, Calif. 95380	(209) 667-5405	· Turlock, Calif.	N/A
Champion Valley Farms, Inc.	P.O. Box 391 Camden, N.J. 08101	(609) 964-4000	· Alabaster, Ala. · Bloomsburg, Pa.	$21-25 million 69-75 million lb
Cole Grain Co.	P.O. Box 1289 Muskogee, Okla. 74401	(918) 687-7565	· Muskogee, Okla.	N/A
Chenango Valley Pet Foods, Inc.	10 West State St. Sherburne, N.Y. 13460	(607) 674-2121	· Sherburne, N.Y.	N/A

(continued)

TABLE A-3 (continued)

Company	Address	Telephone No.	Plant location(s)	U.S. domestic sales volume
	(a) Pet Food Manufacturers			
Cherami Natural Pet Foods, Inc.	34-01 38th Ave. Long Island City, N.Y. 11101	(212) 729-4306	· Long Island City, N.Y.	N/A
Conagra Pet Products Co.	P.O. Box 938 Rolla, Mo. 65401	(314) 364-1312	· Rolla, Mo.	N/A
Cosby-Hodges Milling Co.	P.O. Box 10767 Birmington, Ala. 35202	(205) 322-8581	· Birmingham, Ala.	N/A
Dad's Products Co., Inc.	P.O. Box 451-D Meadville, Pa. 16335	(814) 724-7710	· Meadville, Pa.	$15-20 million 90-100 million lb 2-3 million cases
Deep Run Packing Co., Inc.	P.O. Box 247 Dublin, Pa. 18917	(215) 249-3543	· Dublin, Pa.	Above $6 million Above 1,150,000 cases
Delight Products Co.	1200 Industrial Dr. Springfield, Tenn. 37172	(615) 384-7546	· Springfield, Tenn.	N/A
Deluxe Pet Food, Inc.	2450 W. 3rd Court Hialeah, Fla. 33010	(305) 888-7423	· Hialeah, Fla.	$500,000-$900,000 1-1.5 million lb
Diamond Feeds	P.O. Box 156 Meta, Mo. 65058	(314) 229-4203	· Meta, Mo.	$1,700,000-$2,000,000
Doane Products Co.	P.O. Box 879 Joplin, Mo. 64801	(417) 624-6166	· Joplin, Mo. · Muscatine, Iowa · Tracy, Calif. · Manassas, Va.	Above $50 million
Dry Fork Milling Co., Inc.	P.O. Box 5 Dry Fork, Va. 24549	(804) 432-8127	· Dry Fork, Va.	Above $1,700,000 Above 7,800 tons
Eagle Products	P.O. Box 506 Mishawaka, Ind. 46635	(219) 259-7834	· Michawaka, Ind.	N/A
8 in 1 Pet Products, Inc.	100 Emjay Blvd. Brentwood, N.Y. 11717	(516) 231-8700	· --	N/A
Estech General Chemicals Corp.	P.O. Box 338 E. St. Louis, Ill. 62202	(618) 271-5650	· E. St. Louis, Ill.	N/A
Evanger's Dog & Cat Food Co., Inc.	221 Wheeling Rd. Wheeling, Ill. 60090	(312) 537-0102	· Wheeling, Ill.	N/A

(continued)

TABLE A-3 (continued)

Company	Address	Telephone No.	Plant location(s)	U.S. domestic sales volume
		(a) Pet Food Manufacturers		
Cherami Natural Pet Foods, Inc.	34-01 38th Ave. Long Island City, N.Y. 11101	(212) 729-4306	· Long Island City, N.Y.	N/A
Conagra Pet Products Co.	P.O. Box 938 Rolla, Mo. 65401	(314) 364-1312	· Rolla, Mo.	N/A
Cosby-Hodges Milling Co.	P.O. Box 10767 Birmington, Ala. 35202	(205) 322-8581	· Birmingham, Ala.	N/A
Dad's Products Co., Inc.	P.O. Box 451-D Meadville, Pa. 16335	(814) 724-7710	· Meadville, Pa.	$15-20 million 90-100 million lb 2-3 million cases
Deep Run Packing Co., Inc.	P.O. Box 247 Dublin, Pa. 18917	(215) 249-3543	· Dublin, Pa.	Above $6 million Above 1,150,000 cases
Delight Products Co.	1200 Industrial Dr. Springfield, Tenn. 37172	(615) 384-7546	· Springfield, Tenn.	N/A
Deluxe Pet Food, Inc.	2450 W. 3rd Court Hialeah, Fla. 33010	(305) 888-7423	· Hialeah, Fla.	$500,000-$900,000 1-1.5 million lb
Diamond Feeds	P.O. Box 156 Meta, Mo. 65058	(314) 229-4203	· Meta, Mo.	$1,700,000-$2,000,000
Doane Products Co.	P.O. Box 879 Joplin, Mo. 64801	(417) 624-6166	· Joplin, Mo. · Muscatine, Iowa · Tracy, Calif. · Manassas, Va.	Above $50 million
Dry Fork Milling Co., Inc.	P.O. Box 5 Dry Fork, Va. 24549	(804) 432-8127	· Dry Fork, Va.	Above $1,700,000 Above 7,800 tons
Eagle Products	P.O. Box 506 Mishawaka, Ind. 46635	(219) 259-7834	· Michawaka, Ind.	N/A
8 in 1 Pet Products, Inc.	100 Emjay Blvd. Brentwood, N.Y. 11717	(516) 231-8700	· --	N/A
Estech General Chemicals Corp.	P.O. Box 338 E. St. Louis, Ill. 62202	(618) 271-5650	· E. St. Louis, Ill.	N/A
Evanger's Dog & Cat Food Co., Inc.	221 Wheeling Rd. Wheeling, Ill. 60090	(312) 537-0102	· Wheeling, Ill.	N/A

(continued)

TABLE A-3 (continued)

Company	Address	Telephone No.	Plant location(s)	U.S. domestic sales volume
	(a) Pet Food Manufacturers			
Farmers Energy Corp.	P.O. Box 176 National Stockyards, Ill.	(618) 271-5180	· National Stockyards, Ill.	N/A
Farmland Industries, Inc.	P.O. Box 7305 Kansas City, Mo. 64116	(816) 459-6579	· Kansas City, Mo.	20,000-30,000 tons
Foster Canning Co., Inc.	Railroad Avenue Farmingdale, N.J. 07727	(201) 938-6411	· Farmingdale, N.J.	N/A
Franklin Foods, Inc.	Landis Avenue Norma, N.J. 08347	(609) 696-5000	· Norma, N.J.	Above $4 million
R. T. French Co., The	P.O. Box 23450 Rochester, N.Y. 14692	(716) 482-8000	· Souderton, Pa.	$5-20 million 1-2 million lb
GTA Feeds	P.O. Box 1447 Sioux Falls, S. Dak. 57117	(605) 339-1050	· Owatonna, Minn.	$1-3 million 10-20 million lb
Garver Feed & Supply Co., Inc.	P.O. Box 7756 Madison, Wis. 53707	(608) 244-4739	· Madison, Wis.	N/A
General Foods Corp.	250 North Street White Plains, N.Y. 10625	(914) 683-2500	· Kankakee, Ill. · Topeka, Kans. · Lafayette, Ind.	N/A
Goertzen Processing, Inc.	RR No. 1 Inman, Kans. 67546	(316) 585-6810	· Inman, Kans.	$2-3 million 22-30 million lb
Goff & Co., Inc.	P.O. Box 6248 Bridgeport, Conn. 06606	(203) 374-9237	· --	N/A
Gold Seal Products Co., Inc.	P.O. Box 10131 Birmingham, Ala. 35202	(205) 251-2611	· Birmingham, Ala.	N/A
Gro-Kote, Inc.	P.O. Box 7 Santa Rosa, Calif. 95401	(707) 546-6136	· Santa Rosa, Calif.	Above $300,000
Gurley's, Inc.	P.O. Box 388 Selma, N.C. 27576	(919) 965-2303	· Selma, N.C.	$100-200,000 1-1.5 million lb
Herman Bros. Pet Products	3650 Central Avenue Detroit, Mich. 48210	(313) 843-5430	· Detroit, Mich.	Above $500,000 Above 1,500 tons
Hervin Company	P.O. Box 309 Tualatin, Oreg. 97062	(503) 638-4151	· Tualatin, Oreg.	$25-30 million 100-150 million lb

(continued)

TABLE A-3 (continued)

Company	Address	Telephone No.	Plant location(s)	U.S. domestic sales volume
	(a) Pet Food Manufacturers (continued)			
Hi-Life Packing	P.O. Box 3148 Glen Ellyn, Ill. 60137	(312) 790-1950	· Hamilton, Mich.	N/A
Hi-Vi Dog Food Co.	P.O. Box 128 Rush Springs, Okla. 73082	(405) 476-3267	· Rush Springs, Okla.	$2-3 million
Houle, Inc., E.J.	P.O. Box 370 Forest Lake, Minn. 55025	(612) 464-3326	· Forest Lake, Minn.	$1-2 million
Hubbard Milling Co.	424 N. Front St. Mankato, Minn. 56001	(507) 625-1882	· Mankato, Minn. · Minneapolis, Minn. · Louisville, Ky.	N/A
Huff & Puff Pet Foods, Inc.	P.O. Box 205 Reedville, Va. 22539	(804) 453-4800	· Burgess, Va.	Above $1 million Above 200,000 cases
Iams Food Co.	P.O. Box 862, State Rte. 503 Lewisburg, Ohio 45338	(513) 962-2624	· Lewisburg, Ohio · Dayton, Ohio	N/A
Ingmand Co., Eugene	P.O. Box 22 Red Oak, Iowa 51566	(712) 623-4850	· Red Oak, Iowa	N/A
International Multifoods	85h & Marquette Sts. Minneapolis, Minn. 55402	(612) 340-3720	· Webb City, Mo. · Portland, Ind.	N/A
Jim Dandy Co., The (Wilmac Industries)	P.O. Box 10687 Birmingham, Ala. 35202	(205) 251-2113	· --	N/A
Kal Kan Foods, Inc.	3386 E. 44th St. Vernon, Calif. 90058	(213) 587-2727	· Vernon, Calif. · Irvine, Calif. · Columbus, Ohio · Mattoon, Ill.	N/A
Keco Division, Martha White Foods, Inc.	P.O. Box 40 McKenzie, Tenn. 38201	(901) 352-3396	· McKenzie, Tenn.	Above $10 million
Kellogg Seed Co.	P.O. Box 684 Milwaukee, Wis. 53201	(414) 276-0373	· Milwaukee, Wis.	Above $750,000
Key Milling Co.	P.O. Box 116 Clay Center, Kans. 67432	(913) 632-2141	· Clay Center, Kans.	Above $250,000
L.F. Pet Foods Co.	P.O. Box 21466 Los Angeles, Calif. 90021	(213) 627-2503	· --	N/A
Landon Co., Inc.	P.O. Box 457 Delavan, Wis. 53115	(414) 728-9101	· Delavan, Wis.	$8-12 million 1-2 million cases

(continued)

TABLE A-3 (continued)

Company	Address	Telephone No.	Plant location(s)	U.S. domestic sales volume
	(a) Pet Food Manufacturers (continued)			
Lang Feed Co., Inc.	17018 Inkster Rd. Romulus, Mich. 48174	(313) 941-1255	· Romulus, Mich.	Above $1,500,000
Lipscomb Grain & Seed Co., Inc.	P.O. Box 1125 SSS Springfield, Mo. 65805	(417) 869-7246	· Springfield, Mo.	N/A
Lipton Pet Foods, Inc.	800 Sylvan Avenue Englewood Cliffs, N.J. 07632	(201) 567-8000	· Nebraska City, Nebr.	$5-10 million
Lone Star Pet Foods	P.O. Box 9 Nacogdoches, Tex. 75961	(713) 564-3711	· --	N/A
MFC Services, Inc.	P.O. Box 500 Madison, Miss. 39110	(601) 856-2400	· New Albany, Miss.	$2-3 million 18-20 million lb
Martin's Feed Mills, Inc.	P.O. Box 46 New Paris, Ind. 46553	(219) 831-2121	· New Paris, Ind.	N/A
Mavar Shrimp & Oyster Co., Ltd.	P.O. Drawer 208 Biloxi, Miss. 39533	(601) 374-1373	· Biloxi, Miss.	N/A
Mighton Co., S.E.	150 Northfield Rd. Bedford, Ohio 44146	(216) 232-3880	· Bedford, Ohio	N/A
Milum, Inc.	P.O. Box 8566 Pine Bluff, Ark. 71611	(501) 536-9425	· Pine Bluff, Ark.	5-8,000 tons
Nabisco, Inc.	River Road Hanover, N.J. 07936	(201) 884-0500	· Buffalo N.Y. · Denver, Colo.	N/A
New England Fish Co.	P.O. Box C-34900 Seattle, Wash. 98124	(206) 284-2750	· Seattle, Wash.	$10-15 million 1-1.25 million cases
Nutro Products, Inc.	445 Wilson Way City of Industry, Calif. 91744	(213) 968-0532	· City of Industry, Calif.	N/A
Ohio Pet Foods, Inc.	P.O. Box 285 Lisbon, Ohio 44432	(216) 227-9877	· Lisbon, Ohio	$1.5-2 million
Old Mother Hubbard Dog Food Co., Inc.	P.O. Box 1411 Lowell, Mass. 01853	(617) 454-8083	· Lowell, Mass.	Above $2 million
Peerless Pet Foods of Battle Creek, Inc.	P.O. Box 200 Battle Creek, Mich. 49016	(616) 968-8195	· Battle Creek, Mich.	$1-2 million 10-15 million lb
Quaker Oats Co., The	Merchandise Mart Plaza Chicago, Ill. 60654	(312) 222-7111	· Rockford, Ill. · Marion, Ohio · Lawrence, Kans.	N/A

(continued)

TABLE A-3 (continued)

Company	Address	Telephone No.	Plant location(s)	U.S. domestic sales volume
		(a) Pet Food Manufacturers (continued)		
Ralston Purina Co.	Checkerboard Square St. Louis, Mo. 63188	(314) 982-1000	· Clinton, Iowa · Davenport, Iowa · Atlanta, Ga. · Cincinnati, Ohio · Dunkirk, N.Y. · Mechanicsburg, Pa. · Oklahoma City, Okla. · Denver, Colo. · Sparks, Nev. · San Diego, Calif. · Flagstaff, Ariz.	Above $1 billion domestic and international
Reward Co., Inc.	P.O. Box 12548 El Paso, Tex. 79912	(505) 882-3586	· El Paso, Tex.	N/A
Riviana Foods, Inc.	P.O. Box 148 Topeka, Kans. 66601	(913) 354-8523	· Topeka, Kans. · Los Angeles, Calif.	$34-40 million 3.8-4.2 million lb
Schreiber Mills, Inc.	P.O. Box 27 St. Joseph, Mo. 64506	(816) 279-1631	· St. Joseph, Mo.	N/A
Show Bound, Ltd.	RD. No. 1 Spring City, Pa. 19475	(215) 242-2552	· Spring City, Pa.	N/A
Siler City Mills, Inc.	P.O. Box 249 Siler City, N.C. 27344	(919) 742-2166	· Siler City, N.C. · Taylorsville, N.C. · Shelbyville, Tenn.	$20-30 million
Simmons Industries, Inc.	P.O. Box 430 Siloam Springs, Ark. 72761	(501) 524-8151	· Siloam Springs, Ark.	$3.8-6 million 400-600,000 cases
Simonsen Mill, Inc.	P.O. Box 157 Quimby, Iowa 51049	(712) 445-2100	· Quimby, Iowa	$600-800,000 2-2,500 tons
Smith Feed Mill, Inc., W.B.	Route 4 Columbia, Mo. 65201	(314) 445-5913	· Columbia, Mo.	Above $500,000
Solid Gold Health Products for Pets	P.O. Box 2341 La Mesa, Calif. 92041	(714) 465-9507	· La Mesa, Calif.	Above $400,000
Specialty Feeds, Inc.	377 Goodman Rd. Southaven, Miss. 38671	(601) 393-7378	· Southaven, Miss.	$4-5 million 20-25,000 tons
Star Dog Food Co., Inc.	105 E. Water St. Fayette, Ohio 43521	(419) 237-2222	· Fayette, Ohio	$1-1.5 million 7-7.5 million lb

(continued)

TABLE A-3 (continued)

Company	Address	Telephone No.	Plant location(s)	U.S. domestic sales volume
	(a) Pet Food Manufacturers (continued)			
Star-Kist Foods, Inc.	582 Tuna St. Terminal Island, Calif. 90731	(213) 548-4411	· Terminal Island, Calif. · Muscatine, Iowa · Perham, Minn. · El Paso, Tex.	N/A
Strongheart Products, Inc.	P.O. Box 2009 Kansas City, Kans. 66110	(913) 621-4909	· Kansas City, Kans. · Momence, Ill.	1-1.5 million cases
Sun Harbor Industries	2251 San Diego Ave. San Diego, Calif. 92110	(714) 295-1221	· San Diego, Calif.	N/A
Sunshine Mills	P.O. Box S Red Bay, Ala. 35582	(205) 356-4436	· Red Bay, Ala. · Tupelo, Miss.	N/A
Superbowl Pet Foods, Inc.	P.O. Box 86 Maspeth, N.Y. 11378	(212) 786-2468	· Maspeth, N.Y.	N/A
Supreme Pet Foods, Inc.	Highway 12 East DeGraff, Minn. 56233	(612) 843-3911	· DeGraff, Minn.	$3-4 million
Thrivo Co., Inc.	P.O. Box 3517 Phildelphia, Pa. 19123	(215) 925-7717	· Philadelphia, Pa.	N/A
Triumph Pet Industries, Inc.	P.O. Box 100 Hillburn, N.Y. 10391	(914) 357-6666	· Hillburn, N.Y.	Above $7 million
Tyrrell's, Inc.	P.O. Box 30756 Seattle, Wash. 98103	(206) 632-4472	· Seattle, Wash.	N/A
Vulcan Pet, Inc.	P.O. Box 563 Alabaster, Ala. 35007	(205) 663-7111	· Alabaster, Ala.	Above $750,000-$1.8 million
Wardley Products Co., Inc.	One Aquarium Dr. Secaucus, N.J. 07094	(201) 348-4040	· Secaucus, N.J.	N/A
Webster Co., Inc., H.K.	P.O. Box 8 Lawrence, Mass. 01842	(617) 686-4131	· Richford, Vt.	$4-6 million
Winn Packing, Co., Inc.	P.O. Box 1037 Thomasville, Ga.	(912) 226-5965	· Thomasville, Ga.	$1-3 million 100-300,000 cases
Zeigler Bros., Inc.	P.O. Box 95 Gardners, Pa. 17324	(717) 677-6181	· Gardners, Pa.	N/A

(continued)

TABLE A-3 (continued)

Company	Address	Telephone No.	Plant location(s)	U.S. domestic sales volume
	(b) Other SIC 2047 Companies[b]			
Aquarium Stock Co., Inc.	New York, N.Y.			
Armour and Company	Phoenix, Arix.			
Armour-Dial, Inc.	Phoenix, Arix.			
Associated Products, Inc.	New York, N. Y.			
Bio Products, Inc.	Warrenton, Oreg.			
Botkins Grain & Feed Co.	Botkins, Ohio			
Carter-Wallace, Inc.	New York, N.Y.			
Darling-Deleware Co., Inc.	Chicago, Ill.			
Elliott Packing Co.	Dulluth, Minn.			
Fischer Packing Co.	Louisville, Ky.			
Flavorland Industries, Inc.	Denver, Colo.			
Golden Sun Feeds, Inc.	Estherville, Iowa			
Hill's Division	Topeka, Kans.			
L.A. Meta Co., Inc.	Los Angeles, Calif.			
Lewis Food Co.	Long Beach, Calif.			
Liggett Group, Inc.	Montvale, J.J.			
Marshall Mill & Elevator Co.	Marshall, Tex.			
Matanuska Maid, Inc.	Anchorage, Alaska			
Milk Specialties Co.	Dundee, Ill.			
Missouri Farmers Assn., Inc.	Columbia, Mo.			
Mogen David Kosher Meat Products, Corp.	New York, N.Y.			
Montgomery Bucks Farm Bureau Cooperative Assn., Inc.	Souderton, Pa.			
National Can Corp.	Chicago, Ill.			
Poultrymens Cooperative Assn.	Riverside, Calif.			
Ralston Purina	Harmony, Minn.			
Standard Brands, Inc.	New York, N.Y.			
Tri-Mutual, Inc.	Minneapolis, Minn.			
Walnut Grove Products	Atlantic, Iowa			
Wells Division	Monmouth, Ill.			

[a]Source: 1981 Directory of Pet Food Manufacturers, Petfood Industry. May/June 1981.
[b]Sources: (1) Standard and Poor's Register of Corporations, Directors and Executives, Volume 3, 1981; and (2) Directory of private label pet food manufacturers, Petfood Industry, March/April, 1981.

TABLE A-4. BEET SUGAR (SIC 2063) PLANTS[a]

Company/ location/ telephone number	Plants	Date plant erected	Capacity tons of beets/day	Plant personnel	
AMALGAMATED SUGAR COMPANY First Security Bank Bldg. Post Office Box 1520 Ogden, Utah 84402 (801) 399-3431	Mini-Cassia, Idaho	1917	6,450	D. Bennett	F. Franz
	Twin Falls, Idaho	1916	4,500	R. Burton	E. G. Bulgin
	Nampa, Idaho	1942	9,100	L. Blacker	G. Hobbs
	Nyssa, Oregon	1938	6,350	G. Wells	D. Russell
AMERICAN CRYSTAL SUGAR CO. 101 North Third Street Moorhead, Minnesota 56560 (218) 236-4400	Clarksburg, Calif.	1935	3,000	C. B. Gillan	R. J. McGuire
	Moorhead, Minn.	1948	4,600	H. Paul Swenson	R. C. Mont
	Hillsboro, N. Dak.	1974	4,800	J. E. O'Leary	R. W. Thiel
	Crookston, Minn.	1954	4,350	G. E. Claassen	C. G. Fisher
	E. Grand Forks, Minn.	1926	7,200	R. W. Levos	R. L. England
	Drayton, N. Dak.	1965	5,400	C. J. Hendrickson	F. G. Hardwick
AMSTAR CORPORATION New York, New York	--	--	--	--	--
BUCKEYE SUGARS, INC. Ottawa, Ohio 45875 (419) 523-3300	--	--	--	--	--
THE GREAT WESTERN SUGAR CO. Sugar Building 1530 16th Street Post Office Box 5308 Denver, Colorado 80217 (303) 893-4600	--	--	--	--	--
HOLLY SUGAR CORP. Post Office Box 1052 Colorado Springs, Colorado 80901 (303)471-0123	Hamilton City, Calif.	1906	3,000	R. F. Ginn	D. Johns
	Worland, Wyo.	1917	2,200	D. C. Melin	A. W. Pitsch
	Tracy, Calif.	1917	4,200	E. A. Edwards	L. R. Garcia
	Sidney, Mont.	1925	4,200	R. L. Haase	D. W. Lind
	Torrington, Wyo.	1926	3,500	R. W. Fullmer	W. J. Ambiel
	Brawley, Calif.	1947	6,200	W. H. Dunn	R. E. Taylor
	Hereford, Texas	1964	6,200	C. K. Jones	L. S. Harper
HUNT INTERNATIONAL RESOURCES CORP. Dallas, Texas	--	--	--	--	
MICHIGAN SUGAR COMPANY Plaza North - Suite 300 4800 Fashion Square Blvd. Post Office Box 1348 Saginaw, Michigan 48605 (517) 799-7300	Caro, Mich.	1899	2,350	C. J. Silvernail	O. E. Weidman
	Carrollton, Mich.	1902	2,500	R. W. Bush	E. Slagel
	Croswell, Mich.	1902	1,900	H. J. Trowhill	H. L. Draher
	Sebewaing, Mich.	1902	2,600	I. L. Nielsen	R. Jacoby

(continued)

TABLE A-4. (continued)

Company/ location/ telephone number	Plants	Date plant erected	Capacity tons of beets/day	Plant personnel	
MINN-DAK FARMERS COOPERATIVE Wahpeton, North Dakota 58075 (701) 642-8411	Wahpeton, N. Dak.	1974	4,500	G. Rudolph V. Hufford	L. Norman
MONITOR SUGAR COMPANY 2600 South Euclid Avenue Bay City, Michigan 48706 (517) 686-0161	Bay City, Mich.	1901	4,300	J. H. McGuire	
NORTHERN OHIO SUGAR COMPANY Subsidiary of the Great Western Sugar Company Fremont, Ohio 43420 (419) 332-2656	--	--	--	--	--
SOUTHERN MINNESOTA BEET SUGAR COOPERATIVE Box 500 Renville, Minnesota 56284 (612) 329-8305	Renville, Minn.	1975	6,500	E. Tanner D. Ulrich	H. Doerr
SPRECKELS SUGAR DIVISION Amstar Corporation 50 California Street San Francisco, California 94111 (415) 362-5600	Spreckels, Calif. Manteca, Calif. Woodland, Calif. Mendota, Calif. Chandler, Ariz.	1899 1917 1937 1963 1966	6,000 4,200 3,600 4,200 4,200	W. R. Duckworth S. S. Anderson R. W. McEuen J. R. McDougall J. E. Gardiner	J. Jongens A. K. Boyden, Jr. M. T. Quinlan A. J. Daglia M. B. Gathercoal
W. F. STRAUB AND COMPANY Chicago, Illinois	--	--	--	--	--
U AND I INCORPORATED Post Office Box 2308 Tri Cities, Washington 99302 (509) 735-6461	--	--	--	--	--

[a]Sources: (1) American Beet Sugar Companies, 1980-1981 Directory, United States Beet Sugar Association, Washington, D.C.; and (2) Standard and Poor's Register of Corporations, Directors and Executives, Volume 3, 1981.

TABLE A-5. PREPARED FEED AND FEED INGREDIENTS (SIC 2048) PLANTS[a]
(Alfalfa Dehydrating Plants)

Company	Address	Telephone No.	Contact
Albers Dehydrating Company	Box 643, Wisner, Nebraska 68791	(402) 529-3253	Gerald Kane
Alfalfa Plus Inc.	Box 36, Route 1, Industrial Site, York, Nebraska 68467	(402) 362-3366	Stan Klute
Alta Verde Industries	P. O. Box NN, Eagle Pass, Texas 78852	(512) 757-1111	Leon Miller
Arco Dehydrating Company, Inc.	P. O. Box 98, Lake Park, Iowa 51347	(712) 832-3610	Steve Krummen
Arkansas Valley Alfalfa Milling Co.	P. O. Box 217, Wiley, Colorado 81092	(303) 829-4866	Robert Fritz Pampus
B & R Mills, Inc.	27145 Glenwood Road, Perrysburg, Ohio 43551	(419) 874-6967	Willard Brinker
Beermann Bros. Dehy	P. O. Box 158, Dakota City, Nebraska 68731	(402) 987-3422	Richard P. Beermann
Bert & Wetta Sales, Inc.	P. O. Box 317, Maize, Kansas 67101	(316) 722-0240	Ray Bert
Blanton Alfalfa Mills	P. O. Box 458, Hughes, Arkansas 72348	(501) 735-6248	Hubert Blanton
Bram, Inc.	12th & Stubble Ave., Arlington, Nebraska 68002	(402) 478-4344	Howard Rhea
V. C. Britton Company	P. O. Box 397, Firebaugh, California 93622	(209) 659-2021	John Britton
Brown & Brown, Inc.	P. O. Box 7, Leshara, Nebraska 68035	(402) 625-2429	Larry K. Brown
Bruins Planting Co., Inc.	Route 2, Hughes, Arkansas 72348	(501) 339-2793	Walker Milnor
C. K. Processing, Inc.	P. O. Box 58, Salina, Kansas 67401	(913) 823-3794	J. J. Vanier
Carlson & Shull Alfalfa Products, Inc.	Box 87, Crawfordsville, Arkansas 72327	(501) 823-5562	Jimmy Shull
Central Alfalfa, Inc.	P. O. Box 718, Lexington, Nebraska 68850	(308) 324-4631	George Pfister
Chief Alfa Inc.	1000 Oak Street, Grinnell, Iowa 50112		E. T. (Don) Ruppe
Choska Alfalfa Mills, Inc. (Cole Grain Company)	P. O. Box 1289, Muskogee, Oklahoma 74401	(515) 236-4634 (918) 687-7565	James Lang J. D. Cole, Don Cole,
Christiano Alfalfa Milling Co.	RD No. 1, Leicester, New York 14481	(716) 243-2280 or (716) 382-3516	Gerald P. Christiano
Coleman Alfalfa Milling Co.	P. O. Box M, Haven, Kansas 67543	(316) 465-7755	E. S. (Gene) Coleman
Coleridge Dehy Inc.	Box 277, Coleridge, Nebraska 68727	(402) 283-4279	Marvin Domina
Colorado Feeds, Inc.	Route 1, Box 17, McClave, Colorado 81057	(303) 829-4893	Marilyn Pierson
Consolidated Blenders, Inc.	P. O. Box 689, Fremont, Nebraska 68025	(402) 721-7000	Kenneth D. Smith
Consolidated Mills, Inc.	6761 Silberhorn Hwy., P. O. Box 6, Blissfield, Missouri 49228	(517) 486-2151	Gerald Smith
Cozad Alfalfa, Inc.	P. O. Box 61, Cozad, Nebraska 69130	(308) 784-3232	Don Montgomery
Dawson County Feed Products, Inc.	P. O. Box 398, Lexington, Nebraska 68850	(308) 324-2351	Clifford J. Bossung
Dehy, Inc.	P. O. Box 905, Fremont, Nebraska 68025	(402) 721-4207	R. I. (Bob) Smith
Doland Dehy	Doland, South Dakota 57436	(605) 635-6292	Dick Dugan
Dooley & Company	P. O. Box 158, Lansing, Kansas 66043	(913) 727-3579	Bill Dooley
Dudden Mills, Inc.	P. O. Box 97, Venango, Nebraska 69168	(308) 447-5622	Howard Hunter
Eastern Oregon Farming Co.	P. O. Box A, Irrigon, Oregon 97844	(503) 481-2811	Frank Lamb
Enright Mills, Inc.	Box 151, Hoytville, Ohio 43529	(419) 278-2272	Dennie Enright
Florida Pellets Farms, Inc.	1401 Ponce de Leon Blvd., Suite 202 Coral Gables, Florida 33134	(305) 433-4139	Roberto F. Poey
Fredonia Dehydrating & Milling Co.	P. O. Box 577, Fredonia, Kansas 66736	(316) 378-2056	Orrin Odell, Eugene Odell
Gothenburg Alfalfa Products Co., Inc.	P. O. Box 24, Willow Island, Nebraska 69171	Cozad (308) 784-2155 Gothenburg (308) 537-2143	Harvey Sutton

(continued)

TABLE A-5. (continued)

Company	Address	Telephone No.	Contact
Gothenburg Feed Products Co.	P. O. Box 409, Gothenburg, Nebraska 69138	(308) 537-3605	Terry Healey
Green Acre Farms	P. O. Box 175, Nazareth, Pennsylvania 18064	(215) 759-2900	Lester H. Miller
Greenbelt Dehy. Co.	Route 3, Vernon, Texas 76384	(817) 553-3192	Charles Schmoker
Green Products Company	Box D, Conrad, Iowa 50621	(515) 366-2001	Jerry R. Schryver
Haymaker Feeds Company	P. O. Box 245, Cozad, Nebraska 69130	(308) 784-3343	Allan Armbruster
Higgins Milling Inc.	Box 391, Schuyler, Nebraska 68661	(402) 352-2404	John Higgins
Hillside Dehy	Box 128, Uehling, Nebraska 68063	(402) 567-2551	Willard D. Heyne
Holtville Alfalfa Mills, Inc.	P. O. Box 235, Holtville, California 92250	(714) 356-2351	Jim McKenzie
Iowa Valley Milling Co.	P. O. Box 547, West Branch, Iowa 52358	(319) 643-2544	Harold R. Spencer
Island Dehy, Inc.	P. O. Box 88, Cozad, Nebraska 69130	(308) 784-2115	David Burkholder
Kaw Dehydrating Co., Inc.	P. O. Box 278, Rossville, Kansas 66533	(913) 584-6107	Robert M. Bunten, Jr.
Kearney Alfalfa Mills, Inc.	P. O. Box 186, Kearney, Nebraska 68847	(308) 234-9926	--
Keystone Dehydrators	Keystone Road, Bethlehem, Pennsylvania 18017	(215) 691-5506	Robert S. Pharo
Land O'Lakes, Inc.,			
AL-FA Meal Division	P. O. Box 1066, Columbus, Nebraska 68601	(402) 564-2746	Charles Farnham
Agricultural Services, Ingredients	2827 8th Avenue South, Ft. Dodge, Iowa 50501	(515) 576-7311	Ron Karstens
Langston Enterprises, Inc.	Route 1, Box 341, Blytheville, Arkansas 72315	(501) 763-6670	Charles C. Langston, Jr.
Le Center Alfalfa Co.	LeCenter, Minnesota 56057	(612) 357-2223	Jasper L. Shaver
Lexington Alfalfa Dehy, Inc.	Box 735, Lexington, Nebraska 68850	(308) 324-2045 or (308) 324-2291	Ken Zimmerman
Longford Mill Products, Inc.	P. O. Box 2, Clay Center, Kansas 67432	(913) 632-2786	C. C. Scripter
Longton Dehy. & Milling Co.	P. O. Box 221, Longton, Kansas 67352	(316) 642-6635	Joe M. Tindle
Lou-Don Milling Co.	8101 S. Highway 95, Yuma, Arizona 85364	(602) 726-1822	Louie Daily, Mike Daily
Loup Valley Alfalfa, Inc.	P. O. Box 574, Burwell, Nebraska 68823	(308) 346-4770	W. F. Manasil
Lowrance Gin & Supply Co., Inc.	P. O. Box 3, Driver, Arkansas 72329	(501) 655-8263 and (501) 655-8516	C. D. Lowrance
M & I Dehy Inc.	Box 387, Manning, Iowa 51455	(712) 653-3160	John Opperman
Morrison & Quirk, Inc.	P. O. Box 609, Hastings, Nebraska 68901	(402) 463-3191	Paul W. Newsome
National Alfalfa Dehy. & Milling Co.	4800 Main Street, Kansas City, Missouri 64112	(816) 753-4501	George Polony
Nebraska Farm Products, Inc.	P. O. Box 88 (120 East 6th St.), Cozad, Nebraska 69130	(308) 784-2116	David Burkholder
Niderost T & A Dehy, Inc.	State Route 1730, Road 2 NW, Quincy, Washington 98848	(509) 785-3521	Larry Tussing
N. American Dehydrating Corp. (A Newhall Company)	P. O. Box 228, Rocky Ford, Colorado 81067	(303) 254-7479	Steve Woodward
Ohio Blenders, Inc.	2404 Summit Street, Toledo, Ohio 43611	(419) 726-2655	Leroy Odegaard
Ohio Dehy, Inc.	P. O. Box 151, Oak Harbor, Ohio 43449	(419) 898-2311	Leroy Odegaard
Orleans Milling Co., Inc.	P. O. Box 300, Orleans, Nebraska 68966	(308) 473-4815	William Peden
Oxford Dehy Company	P. O. Box 606, Oxford, Kansas 67119	(316) 455-2411	H. L. Wells
Perrysburg Alfalfa Mills, Inc.	P. O. Box 187, Perrysburg, Ohio 43551	(419) 874-4525	Fred Smith
Platte Valley Products, Inc.	P. O. Box 618, Lexington, Nebraska 68850	(308) 324-6622	James H. Burnett, R. L. Robertson
R-W Milling Company	Wamego, Kansas 66547	(913) 456-7866	Orville Hupe
Red River Alfalfa Company	P. O. Box 496, Crookston, Minnesota 56716	(218) 281-1455	Scott Eickhof

(continued)

TABLE A-5. (continued)

Company	Address	Telephone No.	Contact
Reelfoot Alfalfa Mill	Highway 78, Tiptonville, Tennessee 38079	(901) 253-7251	Ivan Sullivan
Rural Dehydrators, Inc.	P. O. Box 296, Bird Island, Minnesota 55310	(612) 365-3221	Warren R. Johnson, Barbara J. Johnson
S. H. & P., Inc.	P. O. Box 252, Audubon, Iowa 50025	(712) 563-3616	E. J. Svoboda
S-W Mills Inc.	Route 2, Archbold, Ohio 43502	(419) 445-5206	Ivan Wyse
Chas. H. Schenk & Sons, Inc.	R. R. 7, Box 78, Vincennes, Indiana 47591	(812) 882-4640	Charles W. Schenk, Scott A. Schenk
Scribner Alfalfa, Inc.	Box C, Scribner, Nebraska 68057	(402) 664-2268	Frank Parrett
Shofstall, Inc.	P. O. Box 126, Odessa, Nebraska 68861	(308) 237-3017	Bill Seiler
Sioux Alfalfa Meal Company	P. O. Box 398, Vermillion, South Dakota 57069	(605) 624-8011	Dorn E. Van Cleave, Mrs. Francis M. Van Cleave
Toledo Alfalfa Mills, Inc.	861 South Stadium Road, Oregon, Ohio 43616	(419) 836-3705	Vincent Lumbrezer
Transco Feed Products, Inc.	P. O. Box 117, Nickerson, Nebraska 68044	(402) 721-5727	Thomas J. Mateer
Trexler Farms-Division	Est. Harry C. Trexler, P. O. Box 303 1227 Hamilton Street, Allentown, Pennsylvania 18104	(215) 434-9645	Paul S. Zellers Harold Stahley
Valley Dehy Co., Inc.	P. O. Box 788, Sterling, Colorado 80751	(303) 522-3725	Dale R. McDonald
A. M. Wagner & Sons Dehy	Route 1, Danville, Iowa 52623	(319) 392-4741	Robert Wagner
Waldo Alfalfa Milling Co.	P. O. Box 606, Shawnee, Oklahoma 74801	(405) 273-4081	Bob Waldo
Walker Products Company Inc.	P. O. Box 349, Lincoln, Kansas 67455	(913) 524-4107	Stanley Walker
Western Alfalfa Corporation	P. O. Box 69, Shawnee Mission, Kansas 66201	(913) 362-6300	Charles Enderson
Wildung Alfalfa Mill	P. O. Box 405, Owatonna, Minnesota 55060	(507) 451-2316 (507) 451-2205	Albert C. Ihlenfeld
Williams Dehy, Inc.	P. O. Box 158, Garland, Arkansas 71839	(501) 683-2211	Jack L. Williams
Winside Alfa'fa Dehy, Inc.	P. O. Box 38, Winside, Nebraska 68790	(402) 286-4491	Marvin R. Cherry
Yarnell Bros., Inc.	Box 81, Deshler, Ohio 43516	(419) 278-2831	R. F. Yarnell, R. L. Yarnell

[a]Source: American Dehydrator's Association. Direct Members by Company. Shawnee Mission, Kansas. 1981.

TABLE A-6. ANIMAL AND MARINE FATS AND OILS (SIC 2077) PLANTS[a]

Company	Address	City, ZIP code	Telephone number
	(a) National Renders Association Members[b]		
ALABAMA			
Alabama Hide and Tallow Co. (HI,MBM,SF,TG,EX,DRT)	P.O. Box 1596	Birmingham, 35201	(205) 252-1197
Alabama Renders, Inc. (HI,MBM,SF,TG,DRT)	P.O. Box 2110	Montgomery, 36103	(205) 262-7875
W. B. Riggins Tallow Co., Inc. (HI,MBM,SF,TG)	Route 4, Box 18	Trussville, 35173	(205) 655-3612
Sars, Inc., (MBM,SF,TG)	P.O. Box 8	Loxley, 36551	(205) 964-5069
ARIZONA			
Maricopa By-Products, Inc. (HI,MBM,SF,TG,RF,BM)	3602 West Elwood	Phoenix, 85041	(602) 272-3402
Phoenix Tallow Company (MBM,TG,MM,BM)	2602 S. 15th Avenue	Phoenix, 85007	(602) 254-5971
Tucson Tallow Co., Inc. (HI,MBM,SF,TG,MM,RF)	3928 N. Fairview Road	Tucson, 85705	(602) 887-0440
ARKANSAS			
National By-Products, Inc. (FM,PB,SF,TG,MBM)	P.O. Box 1647	Little Rock, 72203	(501) 376-2036
Standard Rendering Co. (FM,TG,PB)	P.O. Box 578	Russellville, 72801	(501) 968-2567
CALIFORNIA			
Baker Commodities, Inc. (SF,TG,MBM,HI)	4020 Bandini Blvd.	Los Angeles, 90023	(213) 268-2801
Baker Commodities, Inc. (HI,MBM,SF,TG,EX)	P.O. Box 487	Kerman, 93630	(209) 846-9393

(continued)

TABLE A-6. (continued)

Company	Address	City, ZIP code	Telephone number
(a) National Renders Association Members[b]			
CALIFORNIA (continued)			
Bakersfield Tallow Co. (HI,TG,MBM)	P.O. Box 4138	Bakersfield, 93387	(805) 323-8217
Butte Tallow Co., Inc. (HI,TG,MBM)	P.O. Box 1478	Chico, 95927	(916) 343-6076
California Rendering Co. (EX,MBM,SF,TG)	P.O. Box 58725	Los Angeles, 90058	(213) 269-7531
California Spray Dry Co.	P.O. Box 5035	Stockton, 95206	
Darling-Delaware Co., Inc. (EX,FM,HI,MM,MBM,SF,TG,PB, DRT,BM)	P.O. Box 24407	San Francisco, 94124	(415) 647-4890
Del Monte Rendering Co. (MM,SF,TG,MBM,PB,FM,BM)	P.O. Box 24325	San Francisco, 94124	(415) 647-6662
Florin Tallow Company (MBM,TG)	P.O. Box 1036	Dixon, 95353	(916) 441-5811
Modesto Tallow Company (FM,HI,PB,SF,TG,MBM,BM,DRT)	P.O. Box 1036	Modesto, 95353	(209) 522-7224
Omar Rendering (MBM,TG)	P.O. Box 1236	Chula Vista, 92012	(714) 421-8600
Peterson Mfg. Co., Inc. (EX,BM,FM,HI,MBM,SF,TG,RF)	2626 East 25th Street	Los Angeles, 90058	(213) 583-6311
Peterson Mfg. Co., Inc. (MBM,SF,TG)	1600 63rd Street	Emeryville, 94608	(415) 654-5772
Royal Tallow & Soap Co. (EX,FM,HI,MM,MBM,SF,TG,PB, DRT,BM)	P.O. Box 24407	San Francisco, 94124	(415) 647-4890
Royal Tallow & Soap Co. (BM,HI,MBM,FM,PB,TG)	P.O. Box 738	Petaluma, 94952	(707) 762-2731

(continued)

TABLE A-6. (continued)

Company	Address	City, ZIP code	Telephone number
	(a) National Renders Association Members[b]		
CALIFORNIA (continued)			
Sacramento Rendering Co. (EX,HI,MM,MBM,SF,TG,DRT)	P.O. Box 1943	Sacramento, 95809	(916) 363-4821
Salinas Tallow Company, Inc. (RF,TG,HI,MM)	P.O. Box 41	Salinas, 93901	(408) 422-6436
San Jose Tallow Co. (HI,MBM,TG)	P.O. Box 142	San Jose, 95103	(408) 293-5706
West Coast Rendering (TG,MBM,EX,DRT)	4105 Bandini Blvd.	Los Angeles, 90023	(213) 261-4176
COLORADO			
Denver Recycling Co., Pet Food, Edible Tallow (EX,BM,MM,MBM,SF,TG,RF,DRT)	5350 Washington (N.)	Denver, 80216	(303) 825-3702
Grand Valley By-Products Co., Inc. (HI,MBM,TG,FM)	P.O. Box 2143	Grand Junction, 81502	(303) 243-4600
National By-Products, Inc. (MM,MBM,SF,TG)	P.O. Box 16372	Denver, 80216	(303) 571-5047
CONNECTICUT			
Herman Isacs, Inc. (MBM,MM,TG)	P.O. Box 981	Bridgeport, 06601	(203) 334-2134
FLORIDA			
Florida Tallow Corporation (MBM,TG,SF,EX)	P.O. Box 426	Hallandale, 33009	(305) 651-1612
Griffin Industries, Inc. (MBM,TG,HI)	P.O. Box J-Hwy. 221	Hampton, 32044	(904) 964-8083
National By-Products, Inc. (HI,MBM,SF,TG,FM)	P.O. Drawer I	Marianna, 32446	(904) 526-2290

(continued)

TABLE A-6. (continued)

Company	Address	City, ZIP code	Telephone number
	(a) National Renders Association Members[b]		
FLORIDA (continued)			
L.D. Plante, Inc. (SF,TG,MBM,RF,DRT)	Route 2	Oviedo, 32765	(305) 365-3241
Serco (Jacksonville Div.) (MBM,TG,SF,EX)	P.O. Box 68, Sleepy Hollow Rd.	Doctors Inlet, 32030	(904) 264-9541
Serco (Miami Div.) (EX,MM,MBM,SF,TG,RF)	P.O. Box 98	Miami Springs, 33166	(305) 887-7536
Showell Farms Inc. of Florida (FM,PB)	P.O. Box 1040	De Funiak Springs, 32433	(904) 892-3151
Tallowmasters (EX MBM,SF,TG)	9501 NW 106th St.	Miami, 33178	(305) 885-2458
GEORGIA			
Atlanta Processing Co. (MBM,SF,TG)	P.O. Box 68	Conley, 30027	(404) 363-1320
Craig Protein Division, Inc., (MBM,TG,SF)	P.O. Box 126	Dublin, 31021	(912) 272-7340
North Georgia Rendering Co. (FM,PB,SF)	RFD No. 7	Cumming, 30130	(404) 887-6148
ILLINOIS			
The American Meat Packing Corp. c/o HRR Enterprises (BM,SF,TG,HI,DRT)	2129 W. Pershing Road	Chicago, 60609	(312) 376-7735
Darling & Company (EX,FA,FM,MM,MBM,PB,RF, SF,TG)	4650 S. Racine Ave.	Chicago, 60609	(312) 927-3000
Darling-Delaware Co., Inc. (EX,BM,FM,MM,MBM,PB,RF,SF, TG,FA,DRT)	4650 S. Racine Ave.	Chicago 60609	(312) 927-3000

(continued)

TABLE A-6. (continued)

Company	Address	City, ZIP code	Telephone number
(a) National Renders Association Members[b]			
ILLINOIS (continued)			
East St. Louis Rendering Co. (TG,MBM)	P.O. Box 91	National Stockyards, 62071	(618) 271-8190
National By-Products, Inc. (HI,MBM,SF,TG)	P.O. Box 192	Mason City, 62664	(217) 482-3261
Schnowske By-Products, Inc. (HI,MM,SF,TG)	P.O. Box 144	Cambridge, 61238	(309) 937-2112
INDIANA			
Bausback Corp. (HI,MM,MBM,SF,TG,DRT)	P.O. Box 808	Shelbyville, 46176	(317) 398-6618
Grandstaff Rendering Service, Inc. (HI,MBM,PB,TG)	P.O. Box 350	North Manchester, 46962	(219) 982-4424
National By-Products, Inc. (HI,MBM,SF,TG)	P.O. Box 33195	Indianapolis, 46203	(317) 784-4486
Plymouth Fertilizer Co. (HI,MBM,SF,TG)	Rural Route 2, 12091 Plymouth-Goshen Trail	Plymouth, 46563	(219) 936-2144
IOWA			
Alton Rendering Works, Inc. (HI,SF,TG,MM)	P.O. Box 179	Alton, 51003	(712) 756-4115
Carroll By-Products, Inc. (BM,MM,TG,HI,MBM,SF,DRT)	P.O. Box 186, RR 1	Carroll, 51401	(712) 792-3270
Darling & Company (HI,MM,TG,SF)	P.O. Box 269	Tama, 52339	(515) 484-3656
Emmetsburg Rendering Works (HI,TG,MBM,DRT)		Emmetsburg, 50536	(712) 852-4061

(continued)

TABLE A-6. (continued)

Company	Address	City, ZIP code	Telephone number
	(a) National Renders Association Members[b]		
IOWA (continued)			
National By-Products, Inc. (EX,BM,FM,HI,MM,PB,RF,SF, MBM,TG)	P.O. Box 615	Des Moines, 50303	(515) 265-0381
National By-Products Inc. (HI,MBM,SF,TG)	P.O. Box 670	Clinton, 52732	(319) 242-9200
Pocahontas Rendering Co. (HI,SF,MBM,TG,DRT)	P.O. Box 953	Fort Dodge, 50501	(515) 576-3591
Simonsen Mill Inc. (HI,TG,MBM,SF)	P.O. Box 157	Quimby, 51049	(712) 445-2211
Spencer Rendering Co. (HI,MBM,TG)	621 10th Ave., S.E.	Spencer, 51301	(712) 262-1140
KANSAS			
Ellis Rendering Co., Inc. (HI,MBM,TG)	P.O. Box 44	Ellis, 67637	(913) 726-4500
Heizer By-Products, Inc. (TG,HI,MBM)	RR No. 4	Great Bend, 67530	(316) 793-3565
Jayhawk Rendering Inc. (HI,MBM,TG,MM,SF)	P.O. Box 1631, Rt. 1	Garden City, 67846	(316) 276-7618
Liberal By-Products, Inc. (BM,HI,MBM,TG,MM,DRT,SF)	P.O. Box 978	Liberal, 67901	(316) 624-2289, (316) 624-1851
National By-Products, Inc. (HI,MBM,SF,TG,MM)	2050 North Mosley	Wichita, 67214	(316) 264-6951
Standard Rendering Co., (MBM,TG)	P.O. Box 5231	Kansas City, 66105	(913) 321-9328

(continued)

TABLE A-6. (continued)

Company	Address	City, ZIP code	Telephone number
(a) National Renders Association Members[b]			
KENTUCKY			
Griffin Industries, Inc. (FM,HI,MM,MBM,PB,SF,TG,BM,RF, EX,DRT)	4221 Alexandria Pike	Coke Springs, 41076	(606) 781-2010
LOUISIANA			
La Hy-Pro, Inc. (MM,TG)	P.O. Box 73658	Baton Rouge, 70807	(504) 774-1535
Riegel By-Products Co., Inc. (HI,MM,SF,TG)	P.O. Box 7064	Shreveport, 71107	(318) 222-3309
Serco (Holden Division) (TG,MM)	P.O. Box 237	Holden, 70744	(504) 567-3169
Serco (La Division) (MBM,TG)	P.O. Box 25	Arabi, 70032	(504) 271-1031
MARYLAND			
Carroll Braun Co., Inc. (HI,SF,TG,MM)	5836 Meadowridge Rd.	Elkridge, 21227	(301) 796-0779
Darling-Delaware Co., Inc. (MM,SF,TG)	4941 Beech Place	Temple Hills, 20031	(301) 423-4910
Eastern Shore Rendering Co (FM,PB,SF)	R.D. No. 1, Box 125	Linkwood, 21835	(301) 228-1616
Kavanaugh Products, Inc. (HI,SF,TG,MM)	P.O. Box 3420	Baltimore, 21226	(301) 355-4800
E. H. Tolzman & Sons, Inc. (MBM,SF,TG)	3101 Harford Rd., RFD No. 1	Hydes, 21082	(301) 592-2511
MASSACHUSETTS			
Corenco Corp. (EX,MBM,SF,TG,FA,HI,MM,DRT)	525 Woburn St.	Tewksbury, 01876	(617) 454-8811

(continued)

TABLE A-6. (continued)

Company	Address	City, ZIP code	Telephone number
	(a) National Renders Association Members[b]		
MASSACHUSETTS (continued)			
Independent Tallow Co., Inc. (MBM,SF,TG,MM,RF)	39 Cedar St.	Woburn, 01801	(617) 729-2390
MICHIGAN			
Battlecreek Rendering Co. (HI,MBM,SF,TG)	P.O. Box 468	Battle Creek, 49016	(616) 962-2961
Coldwater Rendering Co. (BM,HI,MBM,SF,TG)	85 West Garfield Rd.	Coldwater, 49036	(517) 279-9731
Darling & Company (MBM,TG)	P.O. Box 309, Main Post Office	Dearborn, 48121	(313) 928-7400
Detroit Rendering Co. (EX,HI,MBM,SF,TG,DRT)	1923 Frederick St.	Detroit, 48211	(313) 571-2500
Holland Rendering Co. (FM,HI,MM,SF,TG)	P.O. Box 415A	Holland, 49423	(616) 392-9745
Wayne By-Products Co. (EX,HI,TG,MM,MBM,RF,SF)	630 Buhl Bldg.	Detroit, 48226	(313) 963-3100
MINNESOTA			
Blue Earth Rendering Co. (FM,HI,SF,TG,DRT)	P.O. Box 275	Blue Earth, 56013	(507) 526-3296
Central Bi-Products Co. (FM,HI,MBM,SF,TG,FA,PB,BM)	P.O. Box 319	Redwood Falls, 56283	(507) 637-2938
Minneapolis Hide & Tallow Co. (BM,TG,MBM)	P.O. Box 12547	New Brighton 55112	(612) 645-6344
Northwestern By-Products, Inc. (BM,MBM,TG,HI,SF)	P.O. Box 670	St. Cloud, 56301	(612) 252-1331
Van Hoven Co., Inc. (BM,MBM,SF,TG,DRT)	P.O. Box 56, Stockyards	South S. Paul, 55075	(612) 451-6858

(continued)

TABLE A-6. (continued)

Company	Address	City, ZIP code	Telephone number
	(a) National Renders Association Members[b]		
MINNESOTA (continued)			
Worthington Rendering Co. (HI,FM,TG,PB)	P.O. Box 284	Worthington, 56187	(507) 376-4711
MISSISSIPPI			
Bryan Foods (SF,HI,TG,MBM,BM)	P.O. Box 1177	Westpoint, 39773	(601) 494-3731
Griffin Industries, Inc. (EX,FM,MM,PB,SF,TG,RF, MBM,DRT)	P.O. Box 6838	Jackson, 39212	(601) 372-5212
MISSOURI			
Joplin Rendering Co. (FM,PB,SF)	P.O. Box 907	Joplin, 64801	(417) 623-8027
National By-Products, Inc. (HI,SF,TG,MBM,FA,MM,DRT)	P.O. Box 112	Boonville, 65233	(816) 846-4311
National By-Products, Inc. (HI,MBM,SF,TG)	166 Cherokee St.	St. Louis, 63118	(314) 776-3552
Southwest By-Products, Inc. (FM,MBM,PB,SF,TG,MM,DRT)	P.O. Box 2876 C.S.S.	Springfield, 65803	(417) 833-1214
NEBRASKA			
American Stores Packing Co. (BM,MBM,TG,HI)	P.O. Box 82208	Lincoln, 68501	(402) 475-2002
Breunig Rendering Works, Inc. (HI,TG,MBM,FM)	P.O. Box 306	Wahoo, 68066	(402) 443-3777
Midland By-Products, Inc. (HI,MBM,TG)	P.O. Box 127	Crete, 68333	(402) 826-2118
National By-Products, Inc. (HI,MBM,SF,TG)	P.O. Box 668	Bellevue, 68005	(402) 291-8800

(continued)

TABLE A-6. (continued)

Company	Address	City, ZIP code	Telephone number
	(a) National Renders Association Members[b]		
NEBRASKA (continued)			
Nebraska By-Products, Inc. (HI,TG,MBM,SF,DRT)	P.O. Box 736	Lexington, 68850	(308) 324-5563
Norfolk Rendering Works (EX,HI,MBM,SF,TG,MM,RF)	P.O. Box 1144 (R.R. No. 1)	Norfolk, 68701	(402) 371-4822
Tecumseh Rendering Co., Inc. (FM,HI,TG,DRT)	P.O. Box 259	Tecumseh, 68450	(402) 335-3388
West Point Rendering Co. (HI,MBM,TG)	P.O. Box 157	West Point, 68788	(402) 372-2427
NEVADA			
Reno Rendering Co., (HI,MM,MBM,TG,SF)	1705 N. Wells Ave.	Reno, 89512	(702) 323-0791
NEW JERSEY			
Harrison By-Products Co. (MM,MBM,RF,SF,TG)	P.O. Box 2000	Harrison, 07029	(201) 997-5604
The Standard Tallow Corp. (EX,MM,MBM,RF,TG)	61 Blanchard St.	Newark, 07105	(201) 589-7595
Van Iderstine Co., Inc. (EX,FM,MM,MBM,PB,SF,TG,DRT)	825 Wilson Ave.	Newark, 07105	(201) 465-1900
NEW MEXICO			
Baker Commodities, Inc. (MBM,TG,SF,EX)	P.O. Box 332	Albuquerque, 87103	(505) 243-7739
NEW YORK			
Darling & Co. (IV) (MBM,SF,TG)	P.O. Box 57	Buffalo, 14240	(716) 895-0655
Jamestown Rendering Co., Inc. (IV) (HI,SF,TG,MBM)	P.O. Box 602	Frewsburg, 14738	(716) 569-3425

(continued)

TABLE A-6. (continued)

Company	Address	City, ZIP code	Telephone number
(a) National Renders Association Members[b]			
NEW YORK (continued)			
William Stappenbeck, Inc. (IV) (BM,HI,SF,TG,MBM)	2268 Browncroft Blvd.	Rochester, 14625	(716) 482-1880
NORTH CAROLINA			
Asheville By-Products Corp. (EX,BM,FA,HI,MM,PB,RF,SF, TG,FM)	P.O. Box 85	Asheville, 28802	(919) 272-3121
C & H Processing Corp. (EX,BM,HI,FA,FM,MM,PB,SF, RF,TG)		Sanford, 27330	(919) 272-3121
Cape Fear Feed Products, Inc. (EX,BM,FA,FM,HI,MM,PB,SF, RF,TG)	P.O. Box 1659	Fayetteville, 28302	(919) 272-3121
Carolina By-Products Co., Inc. (BM,EX,FA,FM,HI,MM,MBM,PB, SF,RF,TG,DRT)	Drawer 20687	Greensboro, 27420	(919) 272-3121
Carolina & Southern Proc. Corp. (EX,BM,FA,FM,HI,MM,PB,RF, SF,TG)	P.O. Box 12335	Gastonia, 28052	(919) 272-3121
N.C. Consolidated Hide Co. (HI,SF,TG,MBM)	P.O. Box 643	Goldsboro, 27530	(919) 735-3466
Veterans Grease & Tallow (FM,PB,TG)	P.O. Box 158	Harmony, 28634	(704) 546-2602
NORTH DAKOTA			
Northwest Rendering Co. (HI,MBM,TG)	P.O. Box 12	Minot, 58701	(701) 838-0654

(continued)

TABLE A-6. (continued)

Company	Address	City, ZIP code	Telephone number
	(a) National Renders Association Members[b]		
OHIO			
Cuyahoga Conslidated, Inc. (MBM,TG)	808 Denison Ave.	Cleveland, 44109	(216) 749-1450
Darling & Company (HI,SF,TG,MBM)	P.O. Box 98, Lockland Station	Cincinnati, 45215	(513) 554-1900
Darling & Company (MBM,DRT,TG)	P.O. Box 09027	Cleveland, 44109	(216) 661-9000
Defiance Fertilizer Co. (HI,MBM,TG)	Rt. No. 1, P.O. Box 502	Defiance, 43512	(419) 782-6891
Gallipolis Reduction Co. (TG,MM,RF,SF,MBM,DRT)	P.O. Box 337	Rio Grand, 45674	(614) 245-5514
Holmes By-Products (FM,HI,MM,MBM,PB,SF,TG)	Route 5	Millersburg, 44654	(216) 893-2321
Inland Products, Inc. (HI,MM,MBM,SF,TG,RF,FM,BM)	P.O. Box 926	Columbus, 43216	(614) 444-1127
Kentucky Chemical Ind., Inc. (HI,MBM,SF,TG)	P.O. Box 32099	Cincinnati, 45232	(513) 242-0200
A.W. Stadler, Inc. (EX,BM BM,RF,SF,TG)	3275 West 65th St.	Cleveland, 44102	(216) 651-9300
Wauseon ertilizer Co. (HI,MM,TG)	1-16808-K	Wauseon, 43567	(419) 335-6866
G.A. Wintzer & Son, Co. (FM,HI,MBM,SF,RF,TG)	5 North Blackhood St.	Wapakoneta, 45895	(419) 738-3771
OKLAHOMA			
Oklahoma Rendering Co. (TG,MBM,SF)	P.O. Box 82505, Stockyards Station	Oklahoma City, 73148	(405) 235-8681

(continued)

TABLE A-6. (continued)

Company	Address	City, ZIP code	Telephone number
	(a) National Renders Association Members[b]		
OKLAHOMA (continued)			
Southwest Recyclers, Inc. (MBM,TG,MM,SF)	P.O. Box 25666	Oklahoma City, 73125	(405) 239-2409
Tulsa Rendering Co. (MM,TG)	P.O. Box 86	Collinsville, 74021	(918) 371-2528
OREGON			
Eugene Chemical Works	P.O. Box 244	Harrisburg, 97446	(503) 995-6025
Portland Rendering Co. (TG,MBM)	P.O. Box 17201	Portland, 97217	(503) 269-1101
Southern Oregon Tallow Co., Inc. (HI,MBM,TG)	P.O. Box 244	Eagle Point, 97524	(503) 826-3141
Western States Rendering Co. (TG,SF,EX,MBM)	P.O. Box 17054	Portland, 97217	(503) 289-1221
PENNSYLVANIA			
Allen Products Co., Inc. Pet Food Mfg. (Alpo)	P.O. Box 2187	Allentown, 19001	(215) 395-3301
Corenco Corp. (I) (SF,TG,MBM,EX)	Ara Mingo Ave., and Wheat Sheat Lane	Philadelphia, 19137	(215) 535-8500
Drews By-Products Co. (IV) (MM,SF,TG)	P.O. Box 374, R.D. 3	Burgettstown, 15021	(412) 947-9753
Erie Reduction Co. (IV) (BM,MM,MBM,SF,TG)	P.O. Box 1677	Erie, 16507	(814) 452-3528
Greencastle Products Co., Inc. (I) (HI,SF,TG,MBM,DRT)	P.O. Box 296	Greencastle, 17225	(717) 597-3232
Inland Products Inc. (Pitts Div.) (IV) (MBM,SF,TG,HI,DRT)	Herrs Island	Pittsburgh, 15222	(412) 471-1776

(continued)

TABLE A-6. (continued)

Company	Address	City, ZIP code	Telephone number
	(a) National Renders Association Members[b]		
PENNSYLVANIA (continued)			
Keystone Mutual Shoemaker Co. (I) (MBM,SF,TG,MM)	3000 East Ontario Street	Philadelphia, 19134	(215) 426-5800
North Penn Hide Co. (I) (BM,HI,FM,MM,MBM,PB,SF,TG)	P.O. Box 395	Souderton, 18964	(215) 723-5555
Penn Hide & Rendering Co. (I) (MM,SF,TG,DRT)	P.O. Box 127	Avoca, 18641	(717) 655-1445
Wendell J. Pepson & Sons (IV) (HI,MBM,TG,DRT)	360 Derrick Ave.	Uniontown, 15401	(412) 437-5777
J.O. Ryder Rendering Co., Inc. (I) (BM,HI,MBM,SF,TG,DRT)	P.O. Box 235	Matamoras, 18336	(717) 491-4191
Vogt's Rendering Works (I) (FM,HI,PB,SF,MBM)	R.D. No. 1	Lewistown, 17044	(717) 248-4373
SOUTH DAKOTA			
Dakota By-Products, Inc. (HI,MBM,TG,DRT)	P.O. Box 454	Sioux Falls, 57101	(605) 336-3408
TENNESSEE			
Chattanooga Rendering Co., Inc. (HI,SF,TG,MBM)	P.O. Box 2128	Chattanooga, 37409	(615) 266-2520
Delta By-Products Co. (MBM,TG)	P.O. Box 16394	Memphis, 38116	(901) 396-3341
Knoxville By-Products Co., Inc. (FM,HI,MM,PB,RF,SF,TG)	P.O. Box 6073	Knoxville, 37914	(919) 272-3121
Nashville Recycling Corp. (FM,HI,MBM,TG,DRT)	P.O. Box 5706	Nashville, 37208	(615) 244-5423

(continued)

TABLE A-6. (continued)

Company	Address	City, ZIP code	Telephone number
(a) National Renders Association Members[b]			
TEXAS			
Casuco, Inc. (MBM,TG)	Drawer A	Vinton, 79835	(915) 584-0332
Central Mfg. Co.	P.O. Box 898	Paris, 75460	(214) 784-3436
Central Mfg. Co. (BM,FM,MM,PB,SF,MBM,TG)	P.O. Box 1211	Tyler, 75710	(214) 597-6343
Central Mfg. Co. (BM,FM,MBM,PB,SF,TG,DRT)	P.O. Box 750	Wichita Falls, 76307	(817) 723-0793
Pilgram Industries, Inc. (FM,MBM,PB,SF)	P.O. Box 93	Pittsburg, 75686	(214) 856-3612
South Texas By-Products Co. (HI,MBM,SF,TG)	P.O. Box 209	Los Fresnos, 78566	(512) 233-5691
Texas Rendering Co., Inc. (FM,HI,MBM,SF,PB)	P.O. Box 670	Bastrop, 78602	(512) 321-2511
UTAH			
American Commodities Corp. (BM,HI,MM,MBM,SF,TG,EX)	P.O. Box "B"	Hyrum, 84319	(801) 245-6402
John Kuhni Sons, Inc. (HI,MBM,PB,SF,TG)	P.O. Box 1606	Provo, 84601	(801) 373-7600
VIRGINIA			
Holly Farms Poultry, Ind., Inc. (FM,PB,TG)	P.O. Box 8	Temperanceville, 23447	(804) 823-3471
Kavanaugh Ind., Inc. (HI,MM,SF,TG,MBM)	P.O. Box 999	Lynchburg, 24505	(804) 847-8895
Norfolk Tallow Co., Inc. (MBM,SF,TG,DRT)	P.O. Box 1126	Chesapeake, 23320	(804) 545-2466
Winchester Rendering Co., Inc. (FM,HI,PB,SF,TG)	P.O. Box 871	Winchester, 22601	(703) 877-2590

(continued)

TABLE A-6. (continued)

Company	Address	City, ZIP code	Telephone number
	(a) National Renders Association Members[b]		
WASHINGTON			
Pacific Rendering Co., Inc. (MBM,TG)	2926 16th Ave., S.W.	Seattle, 98134	(206) 622-4024
Puget Sound By-Products Co. (HI,MBM,TG)	P.O. Box 1716	Tacoma, 98401	(206) 572-3922
Seattle Rendering Works, Inc. (MBM,SF,TG,RF)	5795 & 130th Place	Seattle, 98168	(206) 243-7387
Spokane Rendering Co. (SF,TG,EX,MBM)	P.O. Box 157	Spokane, 98111	(509) 535-5435
Yakima Rendering Co. (HI,MBM,TG)	P.O. Box 448	Sunnyside, 98944	(509) 837-6356
WISCONSIN			
Anamax Corp. (EX,HI,MBM,RF,SF,TG,DRT)	P.O. Box 3336	Green Bay, 54303	(414) 494-5233
Nick Beucher & SOns Co. of Wis. Inc. (HI,MBM,SF,TG)	P.O. Box 70, Route 2	Berlin, 54923	(414) 361-2092
Milwaukee Tallow Co., Inc. (BM,HI,MBM,TG,RF,SF,DRT,EX)	P.O. Box 1174	Milwaukee, 53201	(414) 276-5700
North Oaks Processing, Inc. (BM,HI,MBM,SF)	P.O. Box 138	Barron, 54812	(715) 458-2157

EX = Exporter.
FA = Fatty acids.
FM = Feather meal.
HI = Hides.
MM = Meat meal.
MBM = Meat-and-bone meal.
PB = Poultry By-Products Meal.
RF = Refined or treated fats.

TABLE A-6. (continued)

SF = Stabilized animal fats.
TG - Tallow and grease.
[b]DRT = Dry rendered tankage.
[b]Source: Render: The National Magazine of Rendering, National Renders Association, Directory Issue. April 1981.
[c]Source: Standard and Poor's Register of Corporations, Directors and Executives. Volume 3. 1981.

TABLE A-7. DISTILLED, RECTIFIED, AND BLENDED LIQUOR (SIC 2085) PLANTS[a]

Company	Company location
American Brands, Inc.	New York, N.Y.
Austin, Nichols & Company, Inc.	New York, N.Y.
James Barclay & Company, Ltd.	Detroit, Mich.
Barton Brands, Ltd.	Chicago, Ill.
James B. Beam Distilling Company	Chicago, Ill.
Fred A. Beck Company	Indianapolis, Ind.
The Black Prince Distillery, Inc.	Clifton, N.J.
Bohemian Distributing Company	North Hollywood, Calif.
A. Smith Bowman Distillery, Inc.	Sunset Hills, Va.
Brown-Forman Distillers Corporation	Louisville, Ky.
China Trade Corporation	New York, N.Y.
Cointreau, Ltd.	Lawrenceville, N.J.
Jack Daniel Distillery L. Motlow PRP	Lynchburg, Tenn.
John De Kuyper & Son, Inc.	New York, N.Y.
Distillers Company, Ltd. (DEL)	New York, N.Y.
Federal Distillers Inc.	Cambridge, Mass.
Foremost-McKesson, Inc.	San Francisco, Calif.
Glenmore Distilleries Company	Louisville, Ky.
Golden Crown Citrus Corporation/ Venture Coastal	Evanston, Ill.
Grain Processing Corporation	Muscatine, Iowa
Heaven Hill Distilleries, Inc.	Bardstown, Ky.
Heublein, Inc.	Farmington, Conn.
Charles Jacquin Et Cie, Inc.	Philadelphia, Pa.
Laird & Company	Scobeyville, N.J.
Lawrence & Company	Lewistown, Maine
Liggett Group Inc.	Montvale, N.J.
Maker's Mark Distillery, Inc.	Loretto, Ky.
McCormick Distilling Company	Weston, Mo.
Medley Distilling Company	Owensboro, Ky.
Midwest Solvents Company	Atchison, Kans.
Montebello Brands, Inc.	Baltimore, Md.
National Distillers & Chemical Corp.	New York, N.Y.
Norton Simon, Inc.	New York, N.Y.
Old Fitzgerald Distillery, Inc.	Louisville, Ky.
Publicker Industries Inc.	Greenwich, Conn.
Rapid-American Corporation	New York, N.Y.
Schenley Industries, Inc.	New York, N.Y.
Joseph E. Seagram & Sons, Inc.	New York, N.Y.

(continued)

TABLE A-7. (continued)

Company	Company location
Standard Brands Incorporated	New York, N.Y.
Standard Distillers Products Inc.	Baltimore, Md.
F. Strauss & Son, Inc. of New Orleans	New Orleans, La.
Sun-Maid Growers of California	Kingsburg, Calif.
Todhunter International, Inc.	West Palm Beach, Fla.
Tribuno Wines Inc.	Lodi, N.J.
M. S. Walker, Inc.	Boston, Mass.
Julius Wile Sons & Company, Inc.	New Hyde Park, N.Y.
Willett Distilling Company	Bardstown, N.Y.

[a]Source: Standard and Poor's Register of Corporations, Directors and Executives. Volume 3. 1981.

TABLE A-8. MALT BEVERAGE PLANTS[a]

Company	Company location
Anheuser-Busch, Inc.	St. Louis, Mo.
Blitz-Weinhard Company	Portland, Oreg.
Carling National Breweries, Inc.	Baltimore, Md.
Champale, Inc.	Trenton, N.J.
China Trade Corporation	New York, N.Y.
Adolph Coors Company	Golden, Colo.
Dixie Brewing Company, Inc.	New Orleans, La.
Falls City Industries, Inc.	Louisville, Ky.
Falstaff Brewing Corporation	Corte Madera, Calif.
Genesee Brewing Company, Inc.	Rochester, N.Y.
G. Heileman Brewing Company, Inc.	La Crose, Wis.
Iroquois Brands, Ltd.	Greenwich, Conn.
Fred Koch Brewery	Dunkirk, N.Y.
Jacob Leinenkugel Brewing Company	Chippewa Falls, Wis.
Lion Inc.	Wilkes-Barre, Pa.
Lone Star Brewing Company, Inc.	San Antonio, Tex.
Lucky Breweries, Inc.	San Francisco, Calif.
Miller Brewing Company	Milwaukee, Wis.
Nor-Cal Beverage Company	W. Sacramento, Calif.
Norlin Corporation	White Plains, N.Y.
Olympia Brewing Company	Olympia, Wash.
Pabst Brewing Company	Milwaukee, Wis.
Pearl Brewing Company	San Antonio, Tex.
Philip Morris, Inc.	New York, N.Y.
Pittsburgh Brewing Company	Pittsburgh, Pa.
Queen City Brewing Company	Cumberland, Md.
Rainier Brewing Company	Seattle, Wash.
The F.M. Schaefer Brewing Company	New York, N.Y.
Jos. Schlitz Brewing Company	Milwaukee, Wis.
C. Schmidt & Sons, Inc.	Philadelphia, Pa.
Schreier Malting Company	Sheboygan, Wis.
The Stroh Brewery Company	Detroit, Mich.
Sunset Beverage Company, Inc.	Hawthorne, Calif.
Todhunter International, Inc.	West Palm Beach, Fla.
Walter Brewing Company	Eau Claire, Wis.
West End Brewing Company	Utica, N.Y.
George Wiedemann Brewing Company, Inc.	Newport, Ky
D. G. Yuengling & Son, Inc.	Pottsville, Pa.

[a]Source: Standard and Poor's Register of Corporations, Directors and Executives. Volume 3. 1981.